FLIGHT
and
AIRCRAFT ENGINEER

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FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams : Flightpres, Sedist, London. Telephone : Waterloo 3333 (60 lines.)

COVENTRY: 8 - 10, CORPORATION ST. Telegrams : Autocar, Coventry. Telephone : Coventry 5210.
BIRMINGHAM, 2: KING EDWARD HOUSE, NEW STREET. Telegrams : Autopress, Birmingham. Telephone : Midland 7191 (7 lines).
MANCHESTER, 3: 260, DEANSGATE. Telegrams : Iliffe, Manchester Telephone: Blackfriars 4412 (3 lines) Deansgate 3595 (2 lines)
GLASGOW, C.2: 26B, RENFIELD ST. Telegrams : Iliffe, Glasgow. Telephone : Central 4857

SUBSCRIPTION RATES: Home and Abroad: Twelve months, £3 1s. 0d. Six months, £1 10s. 6d.
BY AIR: To any country in Europe (except Poland). Twelve months, £5 1s. 0d. Six months, £2 10s. 6d. To Canada and U.S.A. Six months, $16

No. 2083. Vol. LIV November 25th, 1948 Thursdays, One Shilling

The Outlook

A Canadian Lead

MINISTERS of Civil Aviation, past and present, have expressed their sympathy with the British flying clubs, and have "looked into the matter" time and again. So far, however, the looking does not appear to have produced any visible results. The clubs are, with a few exceptions, faced with extinction unless action is taken.

Some of the excuses put forward by Government spokesmen have had an air of reasonableness. Others the reverse. Some time ago the Parliamentary Secretary to the Ministry of Civil Aviation used the feeble excuse that it was difficult to sort out the young men who could well afford to pay for their flying from those who needed Government assistance.

Canada takes a different view. The Rt. Hon. C. D. Howe, Canadian Minister of Trade and Commerce, recently announced a grant of 300 dollars to young men trained under the Canadian Government's subsidy plan for producing a greater flow of pilots.

A grant of 100 dollars will be made to clubs and flying schools for every pilot turned out. In addition to that, the young men will themselves receive 100 dollars upon completing training and qualifying for a Transport Department licence. Should a young pilot desire to join, and be accepted by, the R.C.A.F. Reserve or Auxiliary, he will be awarded another 100 dollars.

Mr. Howe expects some 1,500 young men will take advantage of this offer, and expressed the view that the sum of 450,000 dollars would bring considerable benefits by encouraging greater use of Government airports and airfields, more development of airfields by private enterprise, foster the growth of a healthy light aircraft industry, and serve to develop a large repair and accessory business.

While conditions are not exactly the same in this country as in Canada, it does appear likely that comparable benefits would accrue if our own Government would take steps, adjusted to our own requirements, to do something more than "look into the matter." But immediate action is needed if our clubs are to be saved.

Problems and Solutions

THAT the helicopter is emerging from the purely experimental stage and has reached a point where, the basic principles being now fairly well understood, it has become possible to turn attention to detailed improvements, was demonstrated by the combined all-day discussion held last Saturday, jointly by the Royal Aeronautical Association and the Helicopter Association of Great Britain. The fact that such a joint meeting could be held is also proof that the Association is now "accepted" by the older body as an institution the membership of which includes technicians of high repute. That the Association should have attained this status in such a remarkably short space of time is a welcome indication of worth.

An all-day discussion is difficult to arrange satisfactorily, but on this occasion a new method had been adopted, which was both logical and satisfactory. The two papers read during the morning session outlined the problems ahead and criticized certain helicopter features. In the afternoon, three lecturers explained on behalf of their firms what their particular solutions to the problems are.

W/C. Brie has had very long experience of rotary-wing aircraft, and as head of the Helicopter Unit of B.E.A., which has been making experimental mail runs during the summer and is still continuing with development work, he is in a particularly good position to state the operational point of view.

Captain Liptrot is not only Deputy-Director of Research and Development at the Ministry of Supply, but

he has taken the keenest personal interest in rotary-wing flying from the earliest days, and was therefore obviously the right man to state the technical problems.

Equally, Dr. Bennett and Mr. Hafner were well qualified to explain the constructors' approach, as heads of the Fairey and Bristol helicopter divisions respectively. Mr. Shapiro, of Mr. Pullin's team at the Cierva Autogiro Company, had perhaps the most difficult task in that the Air Horse has not flown while the Fairey Gyrodyne has established a world's speed record of 124.3 m.p.h. and the Bristol 171 has done a great deal of flying. He was, however, favoured by the fact that the Air Horse is the first three-rotor helicopter and is of very large size, thus lending the added interest of novelty.

Argosies and Costly Bales

EXAMINATION of the Reports and Accounts of the three Airways Corporations discloses the fact that in B.O.A.C. it requires one employee to work for a year to carry five passengers at a loss of £345.

That is one aspect of the situation. There are many others involved in the loss of £11,086,909 incurred by the Corporations. The Reports and Accounts are dealt with elsewhere in this issue, from which it is seen that although B.O.A.C. losses are down by about a million, those of B.E.A.C. are up by more than twice that amount. B.S.A.A. have turned a small profit into a loss of nearly half a million.

Many and varied reasons are given for these increases in losses, among them being the use of a multiplicity of aircraft types and delays in introducing new types.

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It is obvious that the aircraft types in service have an important bearing on the economic picture, but it would be well not to overrate the importance. Even if the three Corporations were presented to-morrow with the types of aircraft most suitable for their purpose, this fact would not by itself turn a loss into a profit.

The United States of America have many advantages which we do not enjoy in this country. They have, it is claimed, the finest commercial aircraft in the world. They have an organization of civil aviation which many hold to be superior to ours. They have geographical advantages compared with ours. And yet most American operators have made substantial losses.

It should be realized that air transport is essentially costly due to the many etceteras rather than to the basic cost of flying. The aim should be to reduce losses, certainly, but little more is to be expected for some time.

ALL THE KING'S MEN: It was with regret that we received news of the King's illness and the consequent cancellation of plans for the Royal visit to Australia and New Zealand. The hope that His Majesty's health will rapidly improve, and that the tour will take place at some later date, will help to reduce the disappointment felt by all concerned, particularly the people of the two Commonwealth countries. The first of the Vickers Vikings of the King's Flight was to have taken off for Australia on Monday next. The five crews of the Royal Flight, which is captained by A. Cdre. E. H. Fielden and commanded by W/C. E. W. Tacon, are seen at R.A.F. Station Benson, their home base.

King's Aircraft: S/L. H. A. Nash, A.F.C., F/Lt. D. Fowkes, F/Lt. L. G. A. Reed, M.V.O., D.F.C., F/Lt. K. C. Hampson, D.F.C.

Queen's Aircraft: S/L. H. F. Payne, M.V.O., A.F.C., F/Lt. A. Browne, F/Lt. F. Myers, A.F.M., F/Lt. J. F. W. Yates, D.F.C.

Staff Aircraft (1): F/Lt. A. J. Lee, F/Lt. J. Higgins, F/Lt. K. Gamble, F/Lt. H. J. Redding.

Staff Aircraft (2): F/Lt. S. N. Sloan, D.F.C., C.G.M., F/Lt. M. E. H. Dawson, D.F.C., D.F.M., F/Lt. M. P. Davies, F/Lt. L. D. Pope, D.F.C.

Workshop: F/Lt. E. B. Trubshaw, F/Lt. E. Brewin, F/Lt. P. H. McKenna, D.F.M., F/Lt. E. Yates.

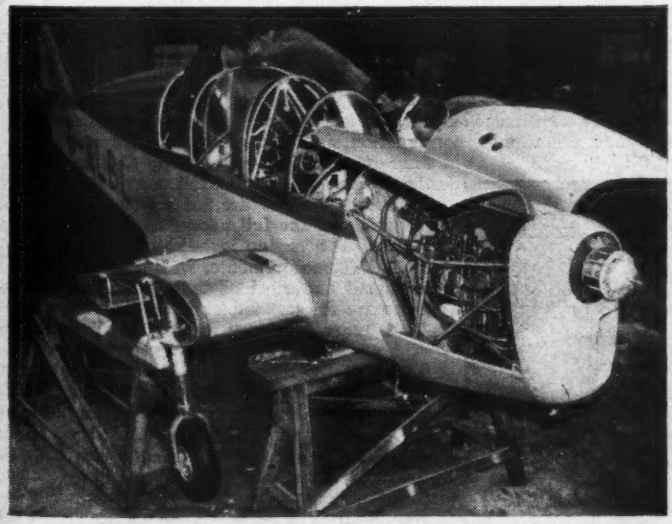
PRIMER PROGRESS

Construction Begins at Hamble : Simplicity of Production

INTRODUCTORY details and handling notes concerning the new two-seat trainer, the Primer, which is now being built by the Fairey Aviation Company, Ltd., at their Hamble works, were given in the February 5, 1948, issue of *Flight*. Construction of the aircraft is at present being carried out on what is mainly a "private venture" basis in anticipation of an increased demand arising in the near future for this type of basic trainer in the R.A.F., and, as a part of this policy, tooling and equipment for quantity production are being developed. It is also intended to offer the licence for building the aircraft abroad.

Even a brief examination of the aircraft, a low-wing monoplane with tandem cockpits, reveals several interesting features, notably an extremely simple welded tubular construction. The design should make the machine suitable for production even under conditions in which factory equipment and skilled labour are limited, as may be the case in a country starting or developing an aircraft industry of its own. In the ordinary way, the construction of an accurate tubular structure by fusion-welding calls for skilled welders and the adoption of special precautions to avoid distortions set up by the considerable expansion and contraction which occurs at the high temperatures required.

This hindrance to manufacture with limited facilities has been almost completely overcome by the adoption of Sifbronze welding—a form of brazing which does not require such high temperatures as the more general ferrous weld, and one which requires neither a high degree of skill nor subsequent heat-treatment. In the past, Sifbronze welding has been widely used by many of our leading constructors, but application has usually been confined to secondary-structure components. The possibilities of the process have, however, been thoroughly investigated and developed by Fairey's, with the result that it has been adopted throughout the structure of the Primer. It is significant that during tests on the process, none of the specimens fractured at the welds but invariably at positions remote from them.



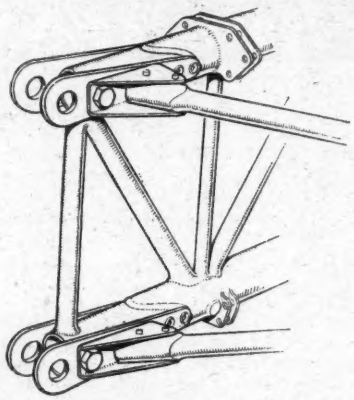
A Primer undergoing overhauls with conversion to Cirrus Major engine installation. The aircraft shown has already completed 50 hours flying with a Gipsy Major.

The fuselage consists of a rectangular, Warren-girder-type tubular structure with an integral centre-section of similar construction, and the external form is established by light secondary structure which supports wooden stringers and fabric covering. On the sides of the fuselage the secondary structure consists of vertical, curved, tubular light-alloy members attached to the longerons top and bottom by split pins which pick up simple plate-fittings welded to the longerons. These curved members form a basis for the attachment of the stringers, which are secured in a somewhat unorthodox manner; they are tied to the curved members, at appropriate spacings, by stout twine, the twine being drawn sufficiently tight to grip the stringers by friction against the members. The method is one which will, no doubt, startle students of design, but is, nevertheless, one which has

Primer Progress . . . . .

proved perfectly satisfactory in service and is at the same time an example of some of the common sense that has been exercised throughout in the design of the machine.

On the top of the fuselage the external shape aft of the cockpit is established in a similar manner by light tubular half-hoops welded to the longerons, and at the pilot's position a crash pylon is provided in the form of a welded pyramidal framing built up on the longerons. Half-hoops similar to those fitted farther aft serve as windscreen framings. Flying controls are almost entirely of the cable type, and interconnection of the dual control columns is by an extremely simple linkage system based on a single tubular member to which both columns are pivoted. Each column is pivoted, for fore-and-aft movement, to a bracket welded to the tube, and the lower ends of the columns coincide with the axis of the tube. Synchronization of the columns is effected by a simple link connecting the two lower ends and passing through the tubular member. The tubular member is in itself pivoted axially, thereby synchronizing both columns for sideways motion.



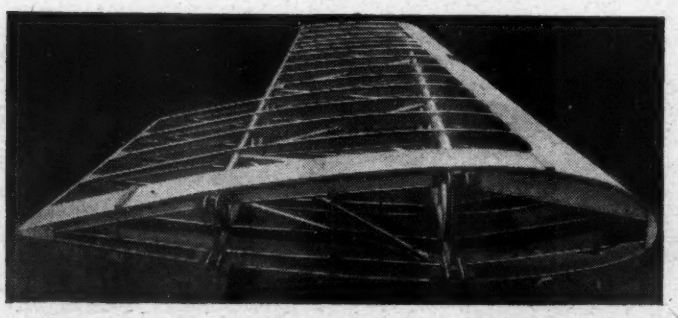
Detail of the outer wing spar pick-up fittings at the centre-section joints.

As already mentioned, the centre-section of the two-spar wing is integral with the fuselage, the spars passing through it, and fuel-tanks are installed between the spars. The spars of both the centre and outer sections consists of pairs of tubular booms interconnected by welded diagonal bracings and the front and rear spars are themselves interconnected by tubular structure.

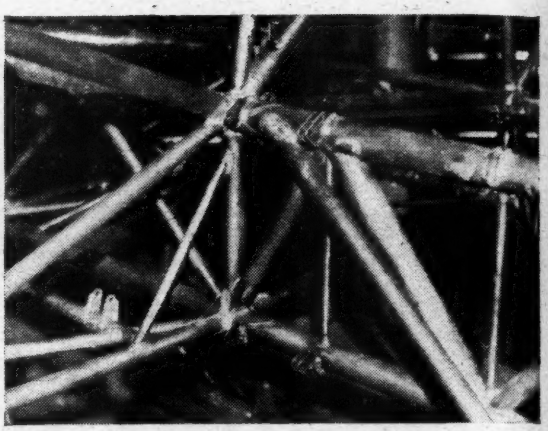
The wing profile is established by wooden ribs which are secured by tubular rivets passing through small kidney-shaped plates tack-welded to the booms. These attachments are another illustration of the ease of manufacture of the aircraft as the plates (already drilled) have only to be placed on the tubes, located in a spanwise and chordwise sense and welded. The leading edges are ply-covered and all-wooden construction is used for the control-surfaces which, like the rest of the aircraft, are fabric covered.

Production-Model Changes

A number of changes have been introduced for the production version of the aircraft (the third example of which is at present undergoing trials and investigation at Boscombe Down), particularly in the matter of equipment.



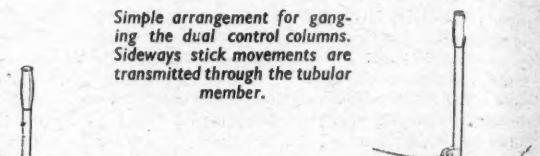
Wing before covering, showing ply nosing, wooden ribs and welded tubular primary structure.



Sifbronze-welded joints at the junction of the centre-section spar with the fuselage—an example of the type of work that can be carried out without the need for skilled welders.

The wheel-spats fitted to the prototype have been discarded as treaded wheels—which tend to accumulate mud—are now fitted, and standard equipment includes a Pesco pump for blind-flying instruments and a 500-watt generator for all electrical services, such as radio, cockpit lighting and navigation lights. The cockpit layout has been completely redesigned and the installations include complete blind-flying equipment, full electrical gear with T.R.1920 radio, electrical intercomm. between pupil and instructor, and two-stage amber equipment for night-flying training. No major changes have been introduced in the flying controls except for small changes to accord with A.R.B. and A.P.970 requirements.

Simple arrangement for ganging the dual control columns. Sideways stick movements are transmitted through the tubular member.

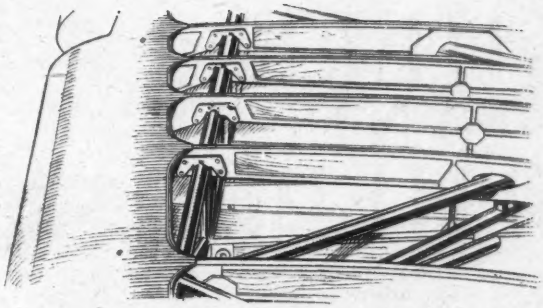


The aircraft can be fitted with either a Gipsy Major or Cirrus Major engine, the mounting, of bronze-welded tubular construction similar to that used throughout the aircraft, differing only in the arrangement of the engine pick-up positions. Appropriate standard cowlings are, of course, fitted, and are designed for full access as the illustration shows. The engine installation is fire-proofed to A.R.B. requirements, with a steel fire-proof bulkhead and steel oil-tank. All fuel and oil pipes are fire-proofed and the Coffman starter—an unusual feature for the relatively small type of engine used—has been retained.

Some indication of the simplicity of manufacture may be gained from the fact that in spite of the extensive production resources of such a large organization as the Fairey company it has not been considered necessary to embark on an extensive tooling programme; in fact, the very opposite is the case. Production equipment has been limited to simple fix-

tures of welded tubular construction, used principally for the later assembly stages of the major components, and there is very little tooling for the details. Construction of the fuselage, for example, consists in the building-up of complete fuselage-side sections in table-type fixtures in which the tubes are located by notches in blocks attached to the table.

The procedure is very like that adopted by model-makers who build their fuselage sides on to a blueprint, completing the structure by setting up the sides and building-in the top and bottom interconnecting structure between the longerons. The routine for the Primer is identical in that the welded fuselage sides are set up in a fixture in which the only locations are those for the ends of the longerons, and trestle-type supports are placed under the longerons at intermediate positions to prevent sagging.

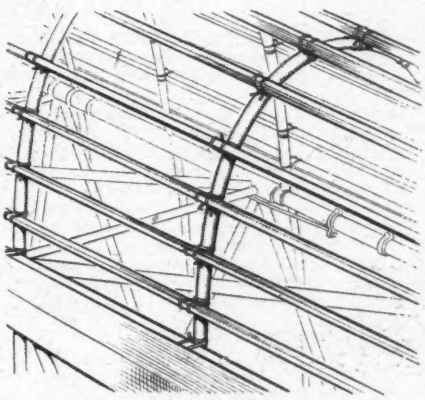


Method of securing the ribs to the spar booms by simple tack-welded plates. The ribs are notched to clear the booms.

Wing Construction

Front and rear centre-section spars are built up in a basically similar manner on turn-over fixtures trunnion-mounted for ease of access to the work, and the spar-sections are related to the fuselage sides by the pick-ups of the inner-to-outer wing joint. Top and bottom bracing is fitted between the longerons by reference to the bracing members already built into the sides, and at the same time the structure connecting the spars to the fuselage sides is installed, together with interconnecting members between the front and rear spars.

Construction of the outer wing is along equally simple lines and is begun by setting up the tubular booms—which have been built up from telescoping lengths of different diameter arranged to give the effect of a spanwise taper—in a fixture in which the booms are located by the ends while the bracing-members are welded in place between the booms. Inter-spar members are received in the form of pre-assembled vees. The arms of the vees are welded to the front spar, and at the rear are connected alternately to the upper and lower booms, thereby contributing considerably to the torsional rigidity of the structure.



An unusual way of attaching stringers. In the Primer these are tied to the secondary structure.

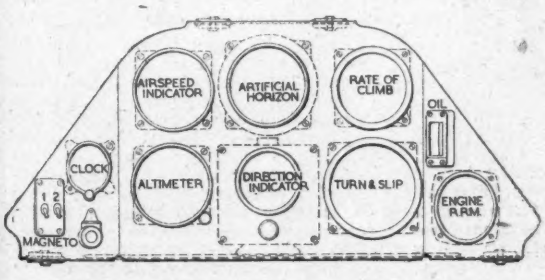
After the joining-up of the front and rear spars by the interconnecting vees, the work of completing the wing entails little more than dropping the ribs into position between the attachment plates and inserting and closing the tubular rivets. The leading-edge and root-end ply covering is then glued to the ribs, and after the installation of control runs, the wing is ready for covering.

In covering the wing there is again a simplification in that no stitching is used, and the edges of the fabric are merely attached to the structure by an adhesive. Where there are joints in the fabric, the joints are formed by doping-strips. As a result, the finished wing-surface is completely free from the irregularities caused by stitching and inter-surface stringing, and presents a pleasingly smooth appearance not usually associated with fabric. The same system is used on the fuselage and control-surfaces as well as on the fin and tailplane.

It will be appreciated from the foregoing brief account of the production routine at Fairey's that the equipment required for building such an aircraft needs only to be of a very rudimentary and economical character, and lends itself to individual ingenuity and improvisation on the part of the constructor, depending on what is available in the way of tooling resources or materials. For instance, it is not difficult to visualize forms of assembly fixtures in which the principal locations are carried on nothing more elaborate than commercial rolled-steel sections set in concrete in the shop floor, or, for building the spars and fuselage sides, wooden table-type fixtures fitted with metal locating-blocks.

The design possesses, moreover, the advantage that for the installation of equipment and controls after completion of the structure it affords an unusual degree of accessibility by comparison with stressed-skin construction. Additionally, in the event of damage, the combination of the tubular construction and Sifbronze welding affords a simple means of repair which can be effected by cutting out damaged members and splicing in new sections by the use of sleeved joints.

S. C. P.



Standard blind-flying panel as fitted in both front and rear cockpits.

HIGH-ALTITUDE, RECORD COURSE

THE need has been felt for some years for a high-altitude course to enable speed record attempts to be made in greater safety. Present regulations specify that speed runs should be made at a height not to exceed 75 metres (246ft). The hazards are obvious.

It is now reported by *American Aviation* that plans are under way for constructing at Muroc, California, a high-altitude speed course, the establishment of which has been made possible by equipment developed by the Air Materiel Command of the U.S.A.F. Radar units will transmit beams upwards from each end of the course, and penetration of these beams, actuating electrical impulses which will stop high-precision clocks, will record the starting and finishing points to one-thousandth of a mile. Additional equipment will ensure that the pilot does not dive his aircraft while on the speed run. Our American contemporary expects that the Muroc course will be completed during the fiscal year 1949. Meantime, steps have been taken by the National Aeronautic Association to obtain official approval, recommending to the F.A.I. that speed records should be permitted at any height up to 50,000ft. The U.S. Air Force is reported to be satisfied that the equipment will measure speed with a maximum error less than 1 per cent; accordingly, the N.A.A. suggests that the previous speed figure be bettered by at least 2 per cent.

HERE AND THERE

Russians Fly British

SPECIALLY chartered by B.E.A. to take a Soviet Mission of 15 delegates to Sydney, Australia, for the fourth session of the Economic Commission for Asia and the Far East, a Dakota was due to leave Northolt on November 22nd. The delegation planned to leave on November 20th but were delayed on their way to London by mechanical trouble and weather. For this flight, the longest charter ever arranged by B.E.A., the crew of the Dakota has been increased from five to seven.

Hard Luck

WHEN making a forced-landing between Fairbanks and Anchorage in Alaska on November 21st, the Proctor piloted by Mrs. Morrow-Tait was damaged. Happily neither she nor Mr. Michael Townsend, her navigator, was injured. A rescue aircraft went to the scene of the accident to pick up Mrs. Morrow-Tait and Mr. Townsend and fly them to Elmford Airfield, Anchorage. The temperature at the time was about 30 deg. F. below zero. Whatever view may be taken as to the value of such flights it is unfortunate that Mrs. Morrow-Tait should have had this mishap when she had completed a large proportion of her round-the-world flight.

Heston Exhibition

IN conjunction with Air Britain, the Heston Community Aviation Club are organizing an exhibition and display to take place at Heston in the Heston Junior School Hall on Saturday, November 27th. Features of this display, which will be opened at 3 p.m. and will remain open until 9.30 p.m., are to be an official attempt on the British Model Aircraft Speed Record for control line machines, a model aircraft competition and an exhibition of model flying by some of the country's leading experts. Stands at this exhibition have been taken by the Fairey Aviation Co., Ltd., Ultra Light Aircraft Association, Sponson Developments, Ltd., The Aircraft Recognition Society and Air Britain.

TAILLESS WONDER: The U.S. Navy's Chance-Vought XF7U-1 deck-landing fighter, the initial trials of which have lately been completed in Maryland. It appears that bulky afterburners are fitted aft of the twin axial-flow Westinghouse turbojets.

Tempests to India

SIX Tempests were recently flown to Cawnpore, India, for Hawker Aircraft Ltd., on behalf of the Royal Indian Air Force. Five of the pilots were provided by Airwork, Ltd., and one by Hawkers. All the Airwork pilots served in the R.A.F., four of them being holders of the D.F.C. The route taken was via Marseilles, Malta, El Adem, Nicosia, Baghdad, Sharjah, Ahmedabad and so on to Cawnpore. All pilots reported an excellent performance from their machines which, with extra drop-tanks, had a range of 1,700 miles.

R.A.A.F. Lectures on Jets

A PARTY of seven jet flying experts headed by Grp. Capt. J. W. Edwardes-Jones arrived at Laverton, Australia, in a Lancaster on November 9th. They are giving a series of lectures on jet flying technique and air/sea warfare developments at R.A.A.F. Stations throughout Australia. The objects of the lectures, which will also cover all aspects of anti-submarine warfare, are to prepare R.A.A.F. personnel for the Vampires which are due for delivery from the de Havilland Bankstown factory early next year.

W.J.A.C. Scholarships

KEMSLEY FLYING TRUST has promised to treble the number of scholarships to be offered by the Women's Junior Air Corps to their members next year, bringing the number to nine. For several years the W.J.A.C. have awarded at least two scholarships annually, consisting of complete free training for a pilot's "A" Licence. Four girls have already qualified for their licences, and received their wings.

Australia's Surplus Aircraft

SERIOUS concern is felt in Australia at the alleged neglect by which large numbers of R.A.A.F. aircraft have been allowed to deteriorate. At many R.A.A.F. stations surplus aircraft, considered by the Air Board to be too valuable to be released through Disposals Commission for sale, have been left unguarded for long periods after being picketed out for storage purposes. In many cases components and instruments have been removed, sometimes with axe and hacksaw, until a large number of aircraft are, for all practical purposes, worthless. In some instances where the

PRUNED: Not a transport development of the Meteor 4 but a Canadian Avro Anson 5 which made a rough landing on the ice of Lake Chipewyan, damaged its starboard wing and, in sub-zero temperatures, underwent an amputation of 9½ feet of the port wing-tip to match. Mr. Tom Fox, the pilot who flew the racy-looking result off the lake, reported good flying characteristics although aileron control was "none too positive" and 28in of boost was required to maintain safe flying speed. The abbreviated Anson flew to McMurray, where wheels replaced skis, and thence to Edmonton. We are indebted to "Canadian Aviation" for the photograph.

HERE AND THERE

aircraft have been stored in hangars, many instruments have been removed and it appears that no attempt has been made to preserve the aircraft for an emergency. It is reported that large quantities of the valuable instruments stolen have been sold at ridiculous prices compared with actual values.

Sperry Instruments for Canadairs

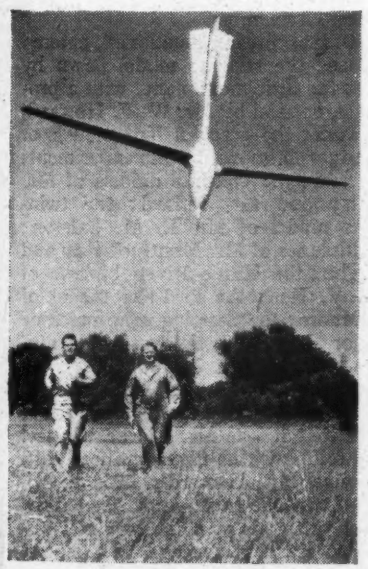
FOLLOWING on the announcement in *Flight*, November 4th, that Canadair Fours now on order for B.O.A.C. are to be fitted with British instruments, it is now learned that Sperry Gyroscope Co., of Brentford, Middlesex, are supplying Sperry Gyrosyn Compasses (type C.L.1) and Electrical Artificial Horizons (type H.L.3) for these aircraft; consignments of these instruments have already been despatched to Canadairs for installation.

S.M.A.E. Ltd.

THE Society of Model Aeronautical Engineers held its first annual general meeting under the new status of the S.M.A.E., Ltd., on November 14th. This followed the annual dinner-dance and prize-giving which took place at the Mecca Restaurant, Whittington Avenue, Leadenhall Street, on November 13th.

American Preference

ADDRESSING the Airways Council of Supervisory Staffs, Executive and Technicians, on November 13th, Mr. Whitney Straight, Managing Director of B.O.A.C., stated that many Americans preferred to travel in British ships such as the *Queen Elizabeth* and *Queen Mary* and he hoped the day would come when American travellers would show similar preference for British aircraft. Britain, he said, had the best designers in the world and the industry's problem was to put their designs into aircraft that could be flown commercially with success.



STRATOSPHERIC DART: Used to recover safely research instruments from experimental high altitude rocket projectiles, this dart-shaped container is under test in America. Its initial high-speed fall is arrested by the vanes which spread out and reduce the speed to about 27 m.p.h. before the nose strikes the ground.

"*Flight*" photograph.

DUTCH RESEARCH: Measuring vibration frequency at positions throughout the fuselage and wings of a Fokker S.11 trainer. Vibration frequencies are indicated visually on a cathode ray screen.

F.B.I. Register Available

PUBLISHED jointly by Kelly's Directories, Ltd., and Iliffe & Sons Ltd., the Federation of British Industries Register of Manufacturers is now available. This latest edition lists nearly 6,000 firms and their products within its total of nearly a thousand pages and contains up-to-date details of many hundreds of new members of the F.B.I. The President of the F.B.I., Sir Frederick Bain, M.C., has described the Register as an "increasingly valuable sales instrument." Home orders for the Register should be sent to Kelly's Directories, Ltd., 196, Strand, London, W.C.2, whereas overseas orders should be addressed to Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1. The price of the Register is 42s, home and overseas, with special terms to F.B.I. members.

News in Brief

THE ashes of Donald Greig who lost his life in the International Gliding Contests in Switzerland during July, were on November 15th, scattered over the downs at Dunstable where he learned gliding.

* * *

The London news bureau of the Lockheed Aircraft Corporation announce that as from Monday, November 15th, their address is 52, Charles Street, Berkeley Square, London, W.1.

* * *

According to reports from Montreal, 60 Canadian Harvards now at Dauphin, Manitoba, are to be reconditioned for delivery to the Chinese Government. They are expected to be ferried to Glendale, California, and flown from there to China. The 60 Harvards are among 200 aircraft purchased by the Chinese Government from Canada.

* * *

In reply to a question by Mr. Platts-Mills recently in the House of Commons, Mr. McNeil, Secretary of State for Foreign Affairs, stated that the consumption of petrol by British aircraft (R.A.F. and civil) engaged on the Berlin air lift was 30,000 tons from June 28th to November 6th inclusive.

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At the invitation of the Commonwealth Government, Marshal of the R.A.F. Lord Douglas of Kirtleside has flown to Australia for a goodwill visit to the R.A.A.F. He is due to arrive at Sydney on November 25th. As a member of the Board of B.O.A.C., he will take the opportunity of visiting bases and examining the organization of the Britain to Australia route.

* * *

At the Public Health and Municipal Engineering Exhibition at Olympia from November 15th-20th, the air survey company of the Hunting Group, Hunting Aerosurveys, Ltd., exhibited on Stand B.91. As the result of the great interest Hunting Aerosurveys' exhibits aroused among public authorities following the last show, a large number of air survey enquiries were received.

* * *

Sold by auction at a Cambridge market recently, a dual-control Tiger Moth fetched £100; it was bought by an agricultural contractor and motor dealer in Cambridgeshire. Apparently the Tiger Moth requires new wings, though the engine has been described as being in good condition. The purchaser is reported as having said that he does not know exactly what he is going to do with it.

* * *

Mr. A. J. Caterer has been appointed Sales Representative covering Scotland, Northern Ireland, Northumberland, Cumberland and Durham for High Duty Alloys, Ltd. Associated with the production activities of the company for several years, Mr. Caterer will operate from the High Duty Alloys Area Sales Office at Winscales, Workington; telephone: Workington 581.

FIRST MODEL MEETING

HARRY HARPER was bitten by the "airitis germ," as he puts it, just fifty years ago. One of his earliest assignments as the first British air correspondent was to report on the model meeting, details of which he here recalls. To his long association with aeronautics he adds a keen interest in astronautics and interplanetary communication, subjects which have held his imagination ever since a first conversation with the famous French engineer, Robert Esnault-Pelterie. He is the author of more than twenty books on aviation

By HARRY HARPER

MODEL aeroplane enthusiasts of to-day will, I imagine, be surprised when I tell them that 41 years ago, in 1907, I was watching the launching of a model propelled through the air by twin rockets. And they will, I fancy, be amused when I add that the gentleman launching this rocket-plane, the first I ever saw, was clad with great formality in a frock coat and top hat.

It was back in 1906, after I had already built man-lifting kites and gliders, and had made sundry adventurous balloon trips with pioneer aeronauts, that flying's great early patron, Lord Northcliffe, commissioned me. from then onwards, to concentrate all my energies on studying and writing about pioneer aviation. This gave me the distinction of being the first regular air correspondent, or air reporter. And it was in the following spring, in April, 1907, that our Aero Club—not yet "Royal"—organized, at the request of Lord Northcliffe, the first official competition for model aeroplanes in this country.

130 Entries

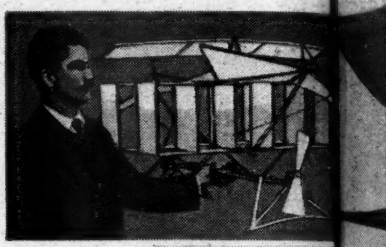
Held under the ægis of *The Daily Mail*, and with its organization in the hands of the late Commander Harold Perrin—already, even in those far-off days, secretary of the Aero Club—this contest produced 130 entries, emanating from all parts of the country.

Prior to the outdoor trials, held in the grounds of the Alexandra Palace, London, on April 15th, we had a pre-view of all the competing machines in the Agricultural Hall, Islington.

In those days many inventors were intrigued by the ornithopter, or flapping-wing machine. A number of the models I inspected at the Agricultural Hall were of this type. But the trouble with the majority of them was that, though ingeniously constructed, they failed to show sufficient stability. All that most of them would do was to make convulsive leaps into the air and then topple over.

I found many inventors had succumbed to the lure of the helicopter. But here again these machines, though they would whizz up off the ground for probably a few feet, left much to be desired in the all-important matters of stability or directional control.

A number of entrants had put in machines of a multiplane type, some driven by very cleverly constructed clockwork power plants. But the trouble with a lot of these machines was that they were constructionally too heavy.

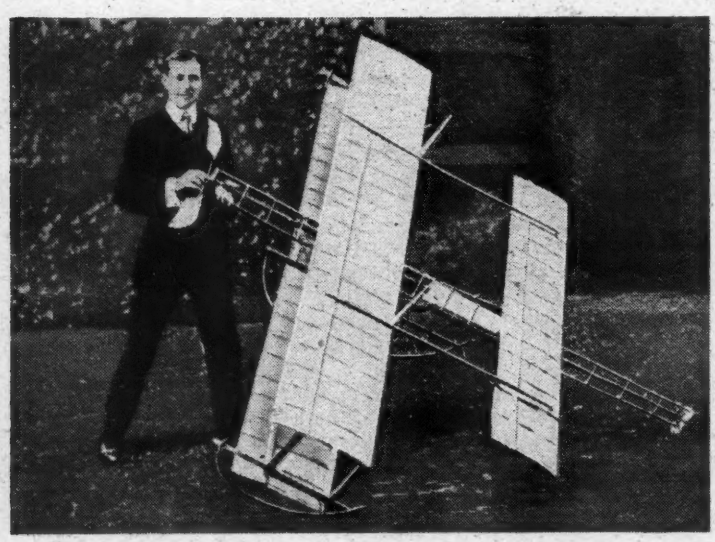


Mr. Henry Crouchley's box-kite model.

After a survey of all models at the Agricultural Hall, the judges decided that only about 30 were promising enough to take part in the main trials at the Alexandra Palace. Among these selected machines I remember particularly the rocket-plane already mentioned, entered by Mr. F. W. Thomas; the triplane model flown by Mr. T. W. K. Clarke; the little monoplane, with a pronounced dihedral angle, entered by Mr. W. F. Howard, and driven by clockwork; the graceful bird models of Mr. Jose Weiss, already well known for his experiments in this field; the box-kite models of Mr. Crouchley and Mr. Piffard; the twin-propeller model of Mr. R. M. Balston; the multiplanes of Mr. Montford-Kay and Mr. Webb; the elastic-driven biplane of Mr. A. V. Roe; the bird-like model of Major Moore; the flapping-wing machine of Major Baden-Powell, and the aluminium model of Mr. Cochrane.

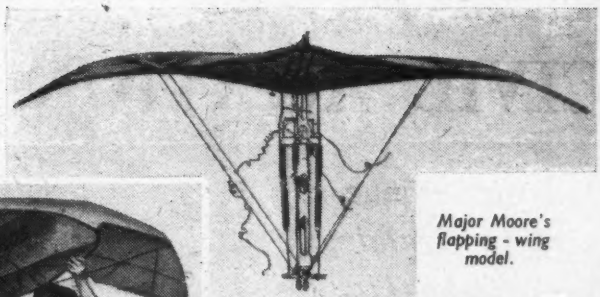
Between 6,000 and 7,000 assembled to watch the Alexandra Palace trials, and I recollect that it was Mr. Clarke who set the ball rolling with a flight of about 40ft. Then came Mr. Howard's little monoplane. After one much-applauded flight of about 75ft, this machine had the misfortune to crash at the end of a second attempt, being damaged badly.

One of our disappointments was the Thomas rocket machine. This started off impressively enough, with smoke stream-

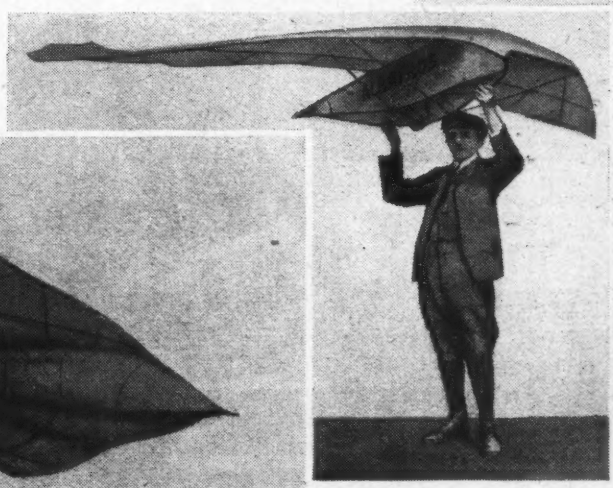


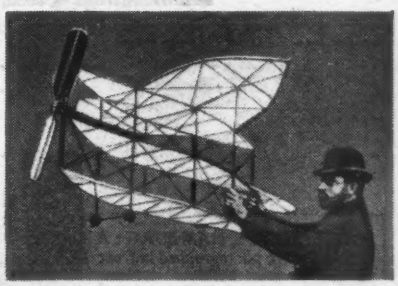
Mr. (now Sir) Alliott Verdon-Roe with his 1907 winning model biplane.

Rocket Flight in 1907: Competition at Alexandra Palace A. V. Roe the Winner

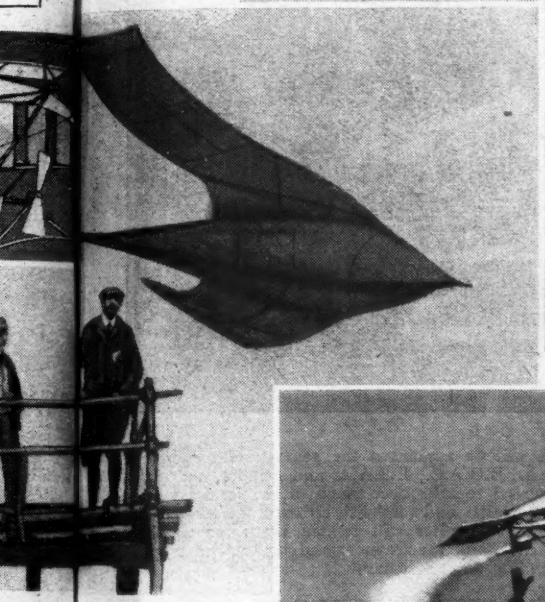


Major Moore's flapping-wing model.





(Centre) Mr. Jose Weiss with one of his bird gliders and (above) Mr. Webb's multiplane model.



(Above) Mr. Jose Weiss launching one of his big bird models.

(Right) Mr. Thomas launching his rocket model.

ing out behind it, but seemed to be climbing too steeply. Then it stalled, and crashed in a nose-dive. Mr. Piffard's model developed a similar nose-dive soon after launching. Mr. Balston's big twin-propeller "bird" made a false start and landed heavily, and I have a vivid recollection of how the Montfort-Kay multiplane, after dashing about here and there on the ground, went careering down a slope, scattering spectators in all directions, and finishing up in a ditch.

The Weiss models gave a good account of themselves, but the outstanding machine of the day was, without doubt, young A. V. Roe's biplane model. At a first attempt it flew about 60ft, and then in a second launching it covered just on 100ft. Apart from the distance actually traversed, what impressed all of us was the machine's smoothness and steadiness in flight, and the obvious way in which its inventor had appreciated those fundamental problems that must be solved in evolving anything like a practical air machine. So I was not surprised when the judges announced Roe the winner, but I certainly was surprised when they said that they had decided to withhold the first prize of £150, and only award Roe the second prize of £75, with Mr. Howard receiving the third prize of £50.

In coming to this decision they had, they explained, been guided by a number of different considerations. In their view no model had secured quite enough points to justify the award of the biggest prize. In this particular case, however, everything ended happily, for it was his success in this model competition which encouraged A. V. Roe to make far more ambitious full-scale experiments, these proceeding stage by stage through the famous family of "Avro" designs. To-day, Sir Alliott Verdon-Roe is chairman of the Saunders-Roe organization which is now building the world's biggest flying-boats.

There is rather a contrast between that little elastic-driven model of 1907 and one of the 140-ton air giants of to-day. In fact, it seems to epitomize, in itself, the mighty strides aviation has taken in only 40 years.

CIVIL AVIATION NEWS

Tourist Revenue : Airline Training for Australia : B.E.A. and Malta Airways

FUHLSBUTTEL, HAMBURG : A B.E.A. Dakota photographed in front of the terminal building at Hamburg Airport. These aircraft are used on the Corporation's freight service between London, Amsterdam, Copenhagen and Hamburg ; B.E.A. are acting here as general agents for K.L.M., S.A.S. and Sabena.

INDIAN CIVIL AVIATION PROGRESS

IN a review of civil aviation in India, Mr. N. C. Ghosh, Director General of Civil Aviation to the Government of India, disclosed recently that between July 1st, 1947, and June 30th, 1948, the number of flying hours had risen to 66,554 from 48,629 in the previous year. The distance flown had increased from 7½ to over 10¼ million miles. Comparative figures showed that the number of passengers carried had also risen from 188,796 to 314,546 and, compared with the previous year, the weight of freight carried had trebled. On the question of training facilities for pilots, engineers and other technical personnel, the Director General said that it had been decided to establish a flying training school and an airfield school at Allahabad and the Government of India were to send six experienced pilots to the U.K. for training as instructors. Some 50 trainer aircraft had been ordered from Canada and the U.K., and these were expected to be delivered shortly. Development work on airfields at present in progress included the bringing of the three airfields, Santa Cruz at Bombay, Dum Dum at Calcutta, and Palam at Delhi, up to international standards. An expenditure of 20 million rupees had been approved for the improvement of other airfields. A regularity factor of 99.7 per cent has been achieved in 1948.

MALTA AIRWAYS

AN official licence has been issued by the Governor to Malta Airways to operate an air service between Malta and Rome (non-stop) and between Malta and the U.K. The terms and conditions of this licence have been made known to and accepted by the Company so that it may be possible to complete arrangements in association with B.E.A. to take over these services. A financial reconstruction of the company has been necessitated and the authorized capital will now be £200,000. The immediate issue of shares include 13,200 £1 fully paid shares to existing Maltese shareholders and 6,800 £1 fully paid shares to B.E.A. A new Board of Directors has been appointed as follows: Col. R. Strickland (Chairman), Lord Amherst, D. Craig, A. Grima, L. Degiorgio. It is intended that the service and travel facilities offered by B.E.A. to the public should operate as previously and Malta Airways has nominated its associate B.E.A. to continue to operate these services as a carrier. During the period of aircraft development the policy has been adopted whereby B.E.A. Viking aircraft flown by B.E.A. crews will continue until it has been decided that Malta Airways would be justified in acquiring its own fleet. Arrangements are being completed whereby Malta Airways will be appointed the general sales agents in Malta for B.E.A., B.O.A.C., B.S.A.A. and Alitalia, and Malta Airways has agreed to take over much of the local handling of passengers, mails and freight hitherto performed by B.O.A.C. Fares and rates will remain the same as those charged by B.E.A. and the frequency of the service may be increased depending on the demand.

CIVIL AIR LIFT'S FIRST HUNDRED DAYS

THE civil side of the Berlin air lift completed its hundredth day on November 11th. B.E.A. who are organizing the civil side of the air lift is now handling 43 aircraft chartered from 20 different companies. During the 100 days 3,994 sorties have been made to Berlin with coal, food, fuel oil, petrol and other supplies. A total of 17,487 metric tons have been transported and on the 99th day the daily record was broken with 96 sorties. At present the air lift fleet which has been organized from the start by Lt.-Col. G. Wharton, O.B.E., the Charter Superintendent of B.E.A., consists of 10 Haltons, 4 Tudors, 5 Lancastrian tankers, 2 Vikings, 2 Hythe flying boats, 17 Dakotas, 2 Bristol Wayfarers and 1 Bristol Freighter.

All the Dakotas and two of the Vikings until recently operating into Berlin were taken off the air lift between November 10th and November 20th as their current contracts expired. As these aircraft were withdrawn the number of Haltons increased from 10 to about 24. The load which the Haltons can carry is more than double that of the Dakotas, 6½ tons as compared with 3 tons 2 cwt. This extra weight factor coupled with the shortage of Dakota spares which has been handicapping their operation are the reasons underlying the change. A further move was to centre all the heaviest aircraft, for example the Tudors and Lancastrian tankers, together with the eight new R.A.F. Hastings, at Schleswigland on about November 14th. By centring all the heaviest aircraft in one place Wunstorf will be left clear for the additional Haltons.

Several marks of Avro Tudor are now engaged, or about to start work, on Berlin supply duties, and the heavy load which they are able to carry on each trip has already been the subject of favourable comment. At the present time, now that the Globemaster has been withdrawn, the Tudor is taking the largest individual load of any aircraft operating into the Berlin airports. It is reported that the Tudor I's load of flour, meat, milk, etc., weighs on an average 20,600 lb and that the two Tudors, a I and V of A.V-M. Bennett's company, Air Flights, which are equipped as tankers to carry fuel (which now has top priority) average 20,000 lb. This represents a

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capacity of 2,500 gallons. Next biggest lift goes to the credit of the Skymasters which average about 19,200 lb. B.S.A.A. are understood to be taking over five Tudors for air lift operations between Wunstorf and Gatow. Tegel, the new airfield in the French sector, came into service last Thursday, November 18th.

TOURIST TRADE FIGURES

THE Travel Association (Tourist Division of the British Tourists and Holidays Board) estimates that in 1949 Britain will receive 560,000 visitors from overseas. An estimate of the amount of money which these visitors will spend in this country and on fares on British owned ships and aircraft is between £47 and £50 million. Figures this year are expected to amount to a total of 500,000 visitors and a fare payment of £40,000,000. An important feature of the remarkable development of tourist trading since the war is its dollar earning capacity. It is estimated that 50 per cent of this year's tourist earnings would be in hard currencies. Latest available figures for 1948 tourist traffic show that in spite of the unsettled international situation 1948 has been a record year for travel to Britain. In the first nine months of the year the total number of overseas visitors was 410,000, which figure excluded "in transit" tourists who, although passing through Britain *en route*, to other destinations, earned British transport services a substantial sum in hard currencies. During the same period all previous tourist records were broken and there are signs that the Travel Association's "staggering" campaign has been successful. For example, in September, a month in which tourist figures normally show a sharp decline, there were this year 42,333 visitors representing an increase of 24 per cent above the average for the years 1936-1938 and 25 per cent more than in September, 1947. American visitors during September totalled 7,646, representing an increase of 46.6 per cent over the corresponding month last year. Accurate figures for October are not yet available but it is known that tourist traffic and bookings were well maintained and that a steady flow may be expected during out-of-season periods. A big advertising campaign is now in progress in America and many millions of folders, booklets and posters encouraging tourists to visit Britain for the forthcoming 1949 season have been distributed throughout the world.

QANTAS TRAINING PLANS

AUSTRALIA'S largest airline training school is to be built at Kingsford Smith Airport, Sydney, by Qantas Empire Airways. The syllabus of instruction will cover engineering, traffic, flying operation, navigation, radio, catering and general staff training. A total of 8,000 sq ft on two floors is to be devoted to the school and will include seven lecture rooms, an engineering demonstration room, a large lecture hall, instructors' offices and rooms for private study. Apart from new staff in need of training, refresher courses will be provided for more experienced members. All Q.E.A. pilots regularly undergo Link training practice for instrument flying and Link facilities will be maintained as a part of the new school. Q.E.A. state that a large and efficient school is necessary to train staff, who cannot receive adequate instruction elsewhere, to fill the vacancies created by the company's expanding overseas operations.

BREVITIES

COMMENCING with the departure of the flying boat *Sussex* from Southampton on November 16th, the B.O.A.C. Solent service to South Africa has been increased to three flights each week.

* * *

On Sunday, November 14th, B.S.A.A. took delivery of their first Tudor IVB for Atlantic operation, for which an increased passenger load was recently approved, as reported in *Flight*, November 18th. It is expected that Tudor IVs will be coming through at a rate of about three per month. After the first six they will be IVCs with galley situated forward of the cabins.

* * *

Excursion fares valid for 30 days are now being offered by B.E.A. between Glasgow and Paris, Marseilles, Nice, Cannes or Monte Carlo and Rome. The fares for these excursions from Glasgow are £25 8s to Paris, £43 8s to Marseilles, £45 6s to Nice, £46 6s to Cannes or Monte Carlo, and £63 18s to Rome; in each case these are return fares.

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The fares for the Aer Lingus winter schedules, referred to in *Flight*, November 11th, show a reduction of the normal rates for the London-Dublin route from £8 5s to £7 14s single and from £14 17s to £13 17s return. A further reduction is offered in the form of a ten-day excursion fare between Dublin and London for £12 12s available for mid-week travel. Excursions valid for three days have also been introduced between Dublin and Liverpool, Manchester and Glasgow. The excursion rates for these are £6 6s and £6 12s on the Liverpool and Manchester trips respectively and £7 5s on the Glasgow route.

* * *

The I.C.A.O. South-east Regional Meeting opened in New Delhi on November 23rd. On the agenda of this meeting are the election of officers of the meeting and explanation of the rules of procedure, the establishment of Credentials Sub-Committee and a Co-ordinating Sub-Committee and of other sub-committees considered necessary. Five technical committees will be established to deal with the following sections: airfields, air routes and ground aids; air traffic control; communications; meteorology; search and rescue. The reports of each of these technical committees will be submitted to the General Committee.

* * *

Airline statistics for Australia for the year ended June, 1948, reveal that the total number of passengers carried was 1,217,178, an increase of 38 per cent. Passenger miles flown were 515,615,787, an increase of 37 per cent. The increase of freight tonnage flown was 110 per cent, to a figure of 26,036 tons. During September A.N.A. exceeded the figure of 2½ million passengers carried during its 12 years of operations, 1½ million of these having been carried in the three post-war years. Capt. Holyman, the Managing Director of A.N.A., has reported that in the first six months of 1948 four new records were established; the hours flown were 56,595, the miles flown 8,589,000, passengers carried, 316,007, freight, 17,153,000 lb.

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K.L.M. completed the 200th return flight on their service between Amsterdam and Curacao in the Dutch West Indies on November 10th. Since February, 1946, when this service was started a total of 12,790 paying passengers, 76,360 lb of freight, 10,225 lb excess baggage, and 38,090 lb of mail have been carried. Operated at first under charter for the Royal Dutch Shell Co. via Dakar and Natal, the service was in June, 1946, flown weekly by DC-4 aircraft by way of Prestwick, Gander and New York. The service operating to-day is thrice weekly by Constellations between Amsterdam and Curacao, the main terminus of the K.L.M. West Indies network.

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Three Constellations belonging to American Overseas Airlines flying from Shannon westbound through Iceland were forced to return to Shannon on November 16th as Keflavik Airport was closed owing to an outbreak of fire. Two machines had completed the flight and circled Keflavik before returning, while the third was turned back one hour out of Shannon. It was later reported from Shannon that the fire was not as serious as it had first appeared to be, and Keflavik was expected to be reopened shortly. Two of the aircraft which returned to Shannon were re-routed via the Azores, the third being held.

* * *

Ground engineers of B.E.A. at Northolt ended the strike, details of which were given in the preceding issue of *Flight*, on November 16th. They resumed work on the premium bonus scheme basis, which had been the cause of the strike, in order that negotiations might be opened concerning the future of this incentive scheme. The Corporation had refused to negotiate with the workers' representatives while the strike was in progress. It is estimated that the loss incurred by B.E.A. as a result of this dispute is between £90,000 and £100,000.

* * *

A survey has recently been completed by the Aviation Research Institute of New York which indicates that since 1938 air traffic has increased by about 1,000 per cent. This survey reports that the regular airlines of the world are now operating in the neighbourhood of 3,650 aircraft with a seating capacity approximating to 87,200 passengers. Russia is excluded from these figures since there are no statistics relating to that country available. The number of aircraft now in operation represents an increase of 83 per cent over the 1938 total and the difference beween this and the large increase of total traffic is accounted for by the extra seating capacity of the newer and bigger aircraft. Aircraft produced in the

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United States, the survey continues, account for about 87½ per cent of the total seating capacity and carry 90 per cent of the world's regular air traffic. Of all the commercial airline transports now in use 78 per cent were manufactured in the United States.

* * *

B.E.A. announce that an extra service has recently been introduced on the Aberdeen-Orkney-Shetlands route. This additional service, which is flown by Rapides, leaves Dyce at 9.15 a.m., calling at Orkney at 10.35 a.m., leaving again at 10.45 a.m. and arriving at the Shetlands at 11.35 a.m. The return service leaves at 12.30, calling at Orkney between 1.20 and 1.35 p.m. and lands at Dyce at 2.55 p.m.

* * *

Mr. A. A. Langridge, M.B.E., Regional Freight Manager of K.L.M., was, on November 16th, presented with a gold badge in recognition of his 25 years' service with the company. The presentation was made by Capt. H. Spry Leverton, O.B.E., Regional Director, on behalf of the President of K.L.M., Dr. Albert Plesman, at an informal ceremony at the Sloane Street offices. Mr. Langridge joined the company in 1923 and was based at Croydon Airport until he was transferred to the London office at the outbreak of war. When K.L.M. resumed operations from London after the war he was appointed Freight Manager.

* * *

United Air Lines have filed with the Civil Aeronautics Board a plan to reduce air travel fares for families. Under this plan an adult who pays a full fare may take members of his or her immediate families, including husband or wife, for half fares on Mondays, Tuesday or Wednesdays. Children between the ages of 2 and 12 have always been carried for half fares and the new scheme would extend this privilge to those between the ages of 12 and 21 when accompanying a full-fare paying parent. One child under two may be carried without charge. In addition to this family travel plan U.A.L. has eliminated surcharge on its DC-6s and plans a 5 per cent discount on regular full-fare round trips. The effective date for this plan was November 15th.

* * *

A new Polish airline is, according to Warsaw reports, to be established to fly a weekly service between Belgrade, Budapest, Warsaw and Copenhagen. Officials of the new airline have stated that it is hoped the service will eliminate the present delays in air travel between the Balkans and the United States.

* * *

Contained in *Notice to Airmen* No. 389 is a warning that pilots of light aircraft should exercise caution when landing in the direction 260 deg at Guernsey as there is no overshoot in the southwest section of the airfield. This notice contains particulars of airfields in the United Kingdom available for use by civil aircraft. In *Notice to Airmen* No. 390 it is announced that the first sheet of the new aeronautical chart series at 1 : 500,000—N.W.50/51½—South England and Wales is now available. It is intended that this series will for civil purposes replace the R.A.F. series GSGS.4369 and 4072 and as from November 16th no further supplies of the special sheet—South England and Wales—GSGS.4369 will be obtainable.

* * *

According to a statistical comparison of air and sea travel across the Atlantic published by the Paris office of Air France, the number of maritime passengers from North America to Europe between January 4th and September 11th was 161,615. During the same period 70,205 passengers crossed to Europe by air, representing 46 per cent of the total. In the opposite direction the number of travellers leaving Europe by sea for North America was 178,694, compared with 94,483 who travelled by air, the ratio being 52 air passengers to 100 sea travellers. During the most intense period, that is between August 6th and September 11th, the number of air passengers averaged 740 per day.

FROM THE CLUBS

HAVING expressed a desire to visit a flying club used by ordinary working people Lord Pakenham, Minister of Civil Aviation, went down to Fairoaks with members of the London Transport Flying Club on November 16th. The Minister travelled from the M.C.A. with Sir Arnold Overton, Permanent Secretary to the Ministry of Civil Aviation, on a bus carrying members of the London Transport Club. He was made an honorary member of the Club and was taken for a flight in a Tiger Moth with the C.F.I. The difficulties of the clubs were explained to Lord Pakenham and he replied that everything possible is being done to render assistance to the clubs and private flying in general. Lord Pakenham in a speech to the members explained his keen interest in the flying club movement and said that it was his desire to see airline and private flying made available not only for the thousands but for the millions. Members of the Midland Bank and Fairoaks Flying Clubs were present at the Minister's visit which lasted about an hour and a half. With a membership of 1,200 the London Transport Club is running at a loss of about £1,000 a year.

BUSMEN'S HOLIDAY: Lord Pakenham photographed at Fairoaks on the occasion of his visit to the London Transport Flying Club on November 16th. He is here seen conversing with Miss Peggy Strutt, a conductress from the Victoria Garage.

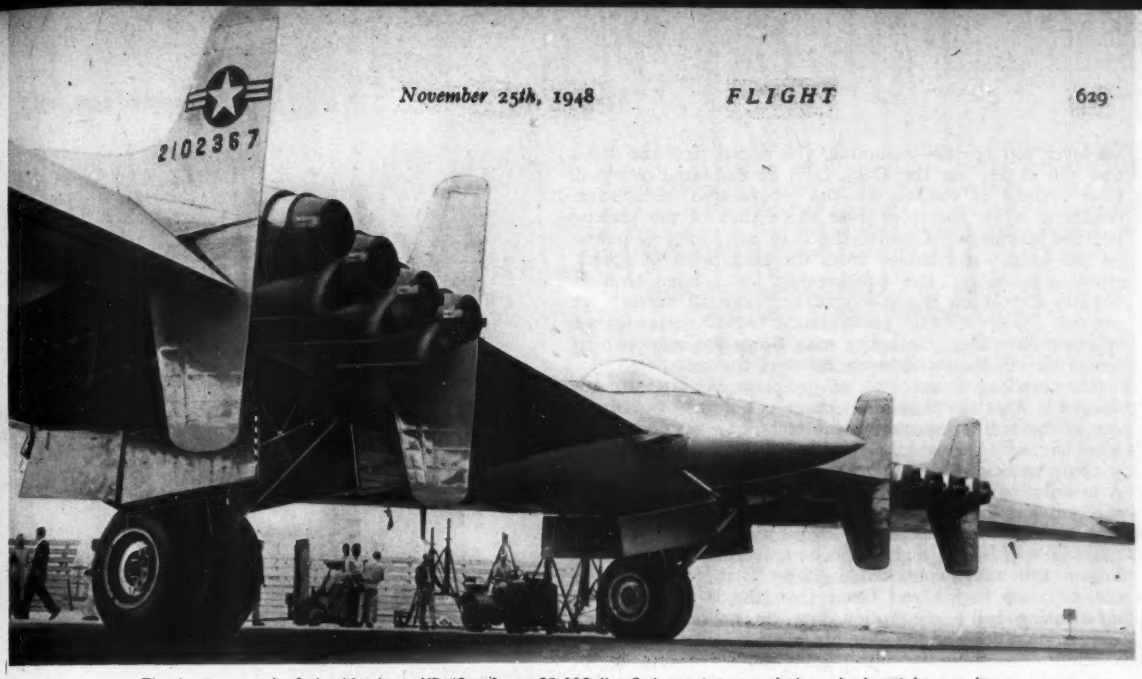
* * *

IN September and October 165 hours were logged at the Cambridge Aero Club. A number of cross country flights were undertaken and a visit was made by Messrs. McGeorge and Thompson in the Club Auster to the air rally at Scion, Switzerland.

* * *

FLYING activities at the Herts and Essex Aero Club during October have been well maintained, a total of 295 hours having been flown. Members have flown to Paris and Copenhagen in a club Auster and Proctor, and a Rapide has been used for charter work, bringing cloth and suitings from Lille; three flights a week are made for this purpose, 1,500 lb being transported on each flight. Visits have been made by an architect member, on business, to Plymouth and Manchester.

A very successful dance was held in the club house on Sunday, November 14th, which was attended by 150 members and their friends; a further dance is planned, though the date has not yet been fixed. At the annual dinner-dance of the club, which will be held at the Park Lane Hotel on December 15th, a special attraction will be the appearances of Kenneth Horne, Jon Pertwee and Helen Hill, the well-known broadcasting personalities. Mr. Geoffrey de Freitas, Under-Secretary of State for Air, is expected to be present, and those who propose attending this event are reminded that it begins with a reception at 6 p.m. for dinner at 6.30 p.m. Arrangements are being made for a coach to transport members to and from the club.



The business end of the Northrop YB-49. Some 32,000 lb of thrust is exerted through the eight nozzles.

ALL-JET BOMBER AIR FORCE-?

U.S. Air Policy and Bomber Development

By "FAVONIUS"

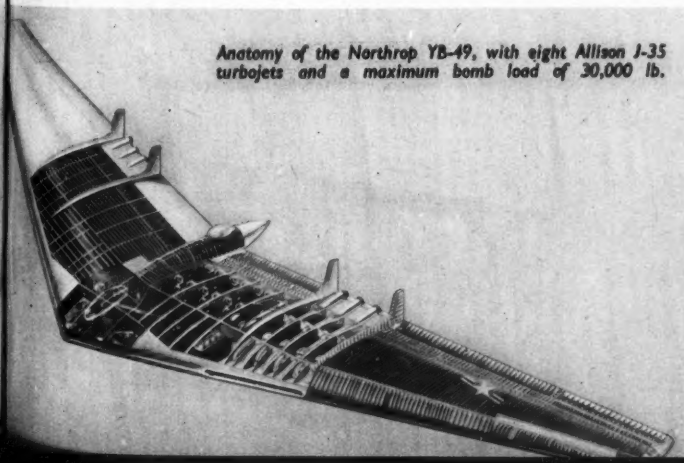
THE question-mark on the signpost suggests that before dismissing the piston-engined bomber as démodé in favour of the pure jet, there may be a middle road worth exploring. In England this middle course is finding fruition in the turboprop combination, whereas in America the piston-turbo compound engine has made bigger strides. The two important gains of compounding are a substantial increase in power and a 20 per cent reduction in specific fuel consumption—albeit obtained at the expense of further mechanical complexity. The Pratt and Whitney Wasp Major, for example, is boosted from 3,500 to 4,000 h.p. for take-off, and from 2,800 to 3,880 h.p. at 30,000ft. This variable discharge turbine model, designated the R-4360-VDT, will power the Boeing B-54 (formerly the B-50C), and may be expected to raise the top speed to 460 m.p.h. at 30,000ft, and to stretch the range about 25 per cent.

American designers, of course, have also seriously studied the long-range potentialities of the turboprop bomber, although the only production engine of that type currently available appears to be the Wright T-35 Typhoon, delivering about 5,000 s.h.p. It is possible that the Boeing XB-52, a 400,000 lb Superfortissimo, has been tentatively designed around this engine; also the Martin XB-51 and Convair XB-53, probably to the same U.S.A.F. specification. Northrop, also, were reported interested in a turbopropped all-wing bomber projected around their own XT-37 Turbodyne engine, which has recently developed about 7,400 s.h.p. Most of these projects, however, seem to be back in the archives—with resulting economy, no doubt, to the American taxpayer. We hope to show that all this middle road exploration is a detour off the stratospheric highway, which leads back to the turbojet for short-, medium- and even long-range bombing.

Northrop B-49

As mentioned previously, the YB-49 is the jet-powered derivative of the B-35. Two of these jets have so far been built and flown, one of which recently blew up in the air and was totally destroyed. Nevertheless, increasing Air Force confidence in the type is indicated by the fact that a further batch of 30 is currently on order, while the remaining YB-35s may also be converted into jets. Further, it is known that negotiations are proceeding for even more substantial quantities from 100 to 500. A high priority is implied by the announcement that the majority of these will be sub-contracted by Northrop for production at the Fort Worth, Texas, plant of Consolidated-Vultee, where they will be built alongside the Convair B-36. The latter firm, although they have vastly bigger production facilities available, did not receive any plums in the shape of original design awards from the new rearmament programme.

The B-49 mounts eight Allison J-35 axial-compressor turbojets, producing a combined static thrust of 32,000 lb. At the respective

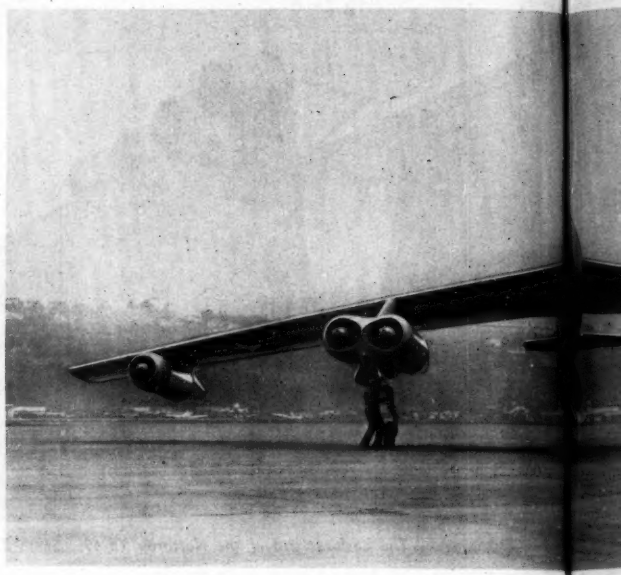


Anatomy of the Northrop YB-49, with eight Allison J-35 turbojets and a maximum bomb load of 30,000 lb.

This is the concluding article in a series of three, reviewing the aircraft authorized under the U.S.A.F. 70-group Rearmament Policy. Previous articles appeared in "Flight," June 10 and October 21, 1948.

sea-level top speeds—assuming 310 m.p.h. for the B-35 and 510 m.p.h. for the B-49, both at the same overload gross weight of 220,000 lb—the jet-powered installation results in a jet thrust of over twice that of the piston-engined prototype. Clearly, the B-49 has plenty of power on the leash; and indeed from the standpoint of speed, climb and ceiling, the performance for a large bomber borders almost on the spectacular. Like all current jet designs, however, this performance begets extravagance in other directions, the major snag being the reduction in range, due to the intemperate thirst of the turbojets.

The cruising economics of jet-powered aircraft are unique in that the maximum range is obtained by climbing as the fuel is consumed, the technique varying somewhat according to whether the optimum cruising altitude is above or below the tropopause—approximately 35,000ft. A heavily loaded jet bomber, such as the B-49, may cover the outward journey to the target within the troposphere and return at stratospheric levels flying at a constant cruising speed—the higher the design cruising speed, the longer the range obtainable. The B-49, for example, cruises much higher and faster than the B-35, but since its cruising fuel consumption rate (in gallons per hour) is more than doubled, its absolute range is still considerably shorter. Assuming an initial gross weight of 220,000 lb, and equal fuel and bomb loads, the respective ranges of jet and piston are approximately 5,400 and 8,400 miles.



ALL-JET BOMBER AIR FORCE—? . . .

This maximum range for the B-49 is obtained by commencing at a cruise altitude of 27,000ft and finishing at 47,000ft, flying at around 400 m.p.h. all the way up what amounts to a very flat aerial hill.

Two points should be emphasized regarding the quoted range figures. In the first place, they are absolute maxima, rather than actual service ranges; that is, they make no allowance for ground operation and climb to the cruising ceiling, nor do they cover such extraneous reserve factors as windage, navigational errors, bombing run tolerances, etc. (Conversely, on the credit side of the account, they also neglect a potential height of 47,000ft at the conclusion of a mission, a useful factor which may be employed to stretch the glide some 200 miles!) The quoted ranges, then, are intended for qualitative comparative purposes, and not as claimants to quantitative accuracy. In any case, the latter is hardly justified in view of the routine of the military planner, who is primarily interested in the operational target radius and will, accordingly, apply his own form of overall "reduction coefficient." Assuming a typical coefficient of 35 per cent for the round trip, the operational radius of the B-49 would be limited at present to about 1,900 miles.

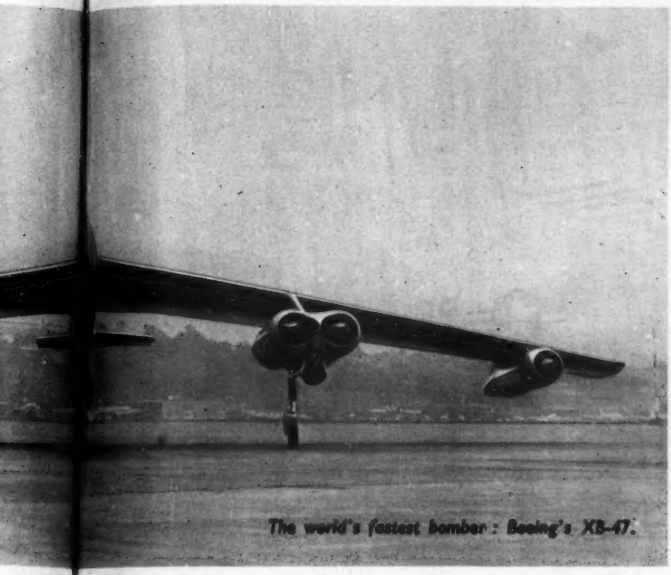
The second point concerning the range prediction of all-wing aircraft is the capacity of this type of structure to accommodate the requisite fuel tankage within the wing envelope, bearing in mind that the thickest half of the wing span is largely occupied by the crew, bomb bay, gun turrets, landing gear housing and power plant. While it is highly probable that the B-49 layout permits a greater fuel capacity than that of the B-35 (since extensive areas formerly occupied by outboard gun turrets and the inner pair of Wasp Majors have become available for tankage in the jet version), the ranges quoted for both aircraft have been computed on the basis of a common fuel load of 90,000 lb, which represents a capacity of approximately 13,000 U.S. gallons of jet fuel. Rough computations indicate that although such a volume is feasible within the B-49 wing geometry, it is open to some doubt in the case of the B-35.

Accurate data on the altitude-speed performance of the B-49 are not possible without knowledge of the critical Mach Number of the wing configuration. The top speed of 510 m.p.h. previously quoted for sea-level is equivalent to M=0.67, which is almost certainly below the critical value. Neglecting compressibility, the B-49 has enough thrust in the region of the tropopause to reach a hypothetical 545 m.p.h. at 35,000ft (M=0.82). Balancing the thick wing characteristics against the moderate sweepback of 24 degrees, a limiting M of about 0.72 appears conservative, which brings the top speed at 35,000ft down to 480 m.p.h. All these figures refer to a gross weight of 220,000 lb, carrying a 30,000 lb bomb load.

At first sight this result may appear disappointing, but in the present state of the art such an assessment would be academic, since even a 500 m.p.h. bomber is seldom required to fly flat out at full throttle. For optimum range, we have postulated that the cruising speed will be constant at 400 m.p.h., which is well below the compressibility régime. This figure, again, is conservative, as it

The double main wheels are visible as the XB-47 approaches

The form of the flaps, and the port slat are seen.



The world's fastest bomber: Boeing's XB-47.

is associated with a moderate cruising thrust ratio of 65 per cent for the J-35 turbojet. When this is raised in the course of further development (or the later model J-47 5,000-lb s.t. engine is substituted), the optimum cruising speed approaches very closely to the all-out compressibility limit. For example, if the cruising thrust of the J-35 is raised to 80 per cent of the normal 4,000 lb rating, the cruising speed is increased to 450 m.p.h. and the range to 6,000 miles, practically all within the stratosphere.

Reference to the performance table shows that the climb characteristics of the B-49 are equally impressive ; thus, with the full overload, the adoption of jets has more than doubled the sea-level climb and lifted the service ceiling some 10,000ft. Other notable improvements directly attributable to the jet substitution are a slightly lower weight empty (88,000 in place of 89,000 lb, despite the big increase in net thrust), and the elimination of most of the extensive six-turret armament installation of the B-35. Because of the big jump in combat performance, the B-49 has been stripped down to only the central tail turret mounting four 0.50-cal. machine guns, a change which results in further weight saving by eliminating two of the gun crew formerly required to operate the remotely controlled outboard wing turrets. The normal operating crew of six now comprises pilot, co-pilot-navigator, radio-operator, flight engineer, bombardier, and gunner.

Both the Northrop "Flying Wings" belong to that class of aircraft which looks all wrong on the ground, but shapes up much better in the air. On the ground the absence of conventional body and tail throws into grotesque relief the parasitic ugliness of the landing gear, but once in the air with everything neatly tucked away, the big wing—particularly the jetted version—takes on a more natural aspect. And since the primary function of an aircraft is to fly, rather than to sit on the ground, one must judge it in its natural habitat.

North American B-45 : Convair XB-46 : Martin XB-48 : Boeing XB-47

While, admittedly, the military qualities of the Flying Wing have still to be evaluated in operational service, the status of the more orthodox jet bomber is not much different. Looking over the list, the North American B-45, with a total of 190 on current order, is the only pure jet bomber actually in quantity production. Powered with four 4,000-lb Allison J-35s, grouped in siamese pairs outboard on the wing, the B-45 is a strictly orthodox job cleanly tailored along typical North American family lines. With a gross weight of 82,600 lb, bomb load of 20,000 lb, and an approximate range of 2,200 miles cruising at 410 m.p.h., it falls within the short-range tactical category. Top speed is officially quoted in the 500-550 m.p.h. class, and on the basis of 16,000 lb s.t., the B.45 should have no difficulty in clocking 530 m.p.h. at sea-level and maintaining it all the way up to the tropopause, where the corresponding M of 0.80 looks a conservative limit.

As an interim short-range type, the B-45 has ousted its Convair XB-46 rival completely out of the running. The power plant of the latter, along with its packaging, is similar to that of the B-45, but although the overall configuration of the XB-46 looks more attenuated, it is actually much larger all round and its aspect ratio is considerably higher. And so it is not surprising to note that the gross weight of the XB-46 is distinctly heavier at 91,000 lb, a penalty which must over-balance the aerodynamic scales in favour of the B-45, despite the difference in aspect ratio. Furthermore, the shorter 89ft 6in wing span of the B-45, compared with the 113ft of the XB-46, clearly foretells a nimbler manœuvrability at low altitude—a point which may have influenced its selection for the role of a low-level attack.

Jumping back up the weight and power scale, two designs in the six-jet category remain for examination. The Martin XB-48 needs only passing mention, as it is unlikely to see the production line at this late date; indeed, aside from its interesting quadri-cycle landing gear—in itself a throw-back to much earlier French-Messier practice—it would seem difficult to justify why such an uninspired design ever got beyond the three-view drawing stage, let alone through the experimental shop. The aerodynamic combination of straight wing and squared-off triple-jet nacelle installation is strikingly unoriginal and hardly capable of further development up the Mach scale. The explanation, no doubt, is that this project was largely conceived by Wright Field before they had become indoctrinated with German high-speed research. (This writer also has a sneaking feeling that the Martin designers are much more at home on the flying boat side—apparently, few firms have been able to pull both a rabbit and a gull out of the same hat!)

With a similar power plant to the Martin XB-48, but obviously belonging to a more advanced design school, the

From astern, the low-slung turbojets are prominent.

Forward of the fuselage markings are ports for the A.T.O. rockets.

Already in hand [illegible] North American B-45 carries 20,000 lb of bombs for 2,000 miles

ALL-JET BOMBER AIR FORCE—? . . .

Boeing XB-47 Stratojet is now well up in the running for future production orders. The combination of thin 35-degree sweptback wing and tail, with underslung stalk-mounted wing engines, makes it easily the most radical-looking jet bomber of the post-war era, whether in the U.S.A. or elsewhere. According to the High Priests of this design philosophy, the XB-47 is an entirely logical trend—the long slender body functioning as the bomb and fuel carrier, while the engines hang low in the breeze, well outboard and clear of the wing.

Judging from recent Russian bombers along similar lines, one suspects that both American and Russian designs can be traced to a common source, for there is a strong flavour of Teutonic wartime research pervading this awkward-looking arrangement. The advocates of this school assure one that the suspended power-egg contributes to the payment of a high Mach dividend—as high as M = 0.95—since apparently the shock wave interaction drag of wing and nacelle is least affected; while, structurally, the relief bending moment from the outboard wing engines is a necessary concomitant of the thin wing. Static balance considerations may also have played a hand in the low forward positioning of the inboard engine nacelles. Anyway, whether or not the fashion spreads, it should delight the heart of the maintenance engineer, who will warmly acclaim the engine accessibility features.

In the static condition the thin wing has a distinctly noticeable droop, in order to avoid an excessive dihedral effect under aerodynamic loading, especially in view of the inherent dihedral characteristics of the sweep-back. Leading-edge slats for lateral control boost and Fowler-type extensible trailing-edge flaps are integral features of the wing design; the slat installation, in fact, is excellently tailored and fits the leading edge like a hand-made glove. To preserve the laminar-flow properties of the low-drag wing and tail surfaces, a special finish is applied over the critical forward portion of the aerofoil profile. This finishing process is also applied to the fuselage nose, engine nacelles and supporting struts.

One other salient design feature—which looks like becoming a fashion—is the quadri-cycle landing gear employing a bicycle main gear mounted in tandem on the body, assisted by a small auxiliary stabilizing wheel under each inboard engine nacelle. The main gear has heavy-duty duplex wheels designed to take the full static load, with the forward pair steerable for ground manœuvring; the outrigger wheels provide lateral support for take-off and landing, but otherwise are not designed to carry any load. The adoption, or rather resurrection, of this type of gear is a commendably logical solution of the retraction problem incurred in thin wing design, since the main gear becomes a straightforward withdrawal into the fuselage, while the auxiliary wheels are readily submerged into the engine nacelles—or, if necessary, the thin wing. A retractable tail skid for "tail down" landings is also mounted at the rear end of the fuselage.

In so far as pure speed performance goes, the XB-47 looks more than a match for current operational jet fighters, such as the Lockheed F-80 and the Republic F-84, although it falls well behind the North American F-86 now coming into service. Because of this useful hit-and-run characteristic, the usual defensive philosophy of earlier bomber designs has been almost entirely abandoned. In place of bristling turrets covering all possible directions, the Stratojet mounts only a pair of .50-cal. machine guns in a remote-control turret at the extreme tail, the radar-operated gun-laying equipment being controlled by the co-pilot-radar-operator member of the three-man crew, who sits directly behind the first pilot. As both pilots sit well forward under a fighter-type bubble canopy in the slim nose, the combat view is excellent.

The third crew member, the navigator-bombardier, is located in the usual position in the nose, the bomb sighting also being done by radar, the equipment for which is installed in a streamlined blister just under the nose of the fuselage. Due to the size of the bomb bay and fuel tank, which together take up the central third of the fuselage length and fill up the entire cross-section, the pressurized crew compartment is confined to the forward portion only. For emergency exit of the two pilots, the bubble canopy is jettisonable, followed by ejector-seat operation.

All-Jet Bomber Air Force . . . . .

Apparently, the bombardier is ejected through an escape hatch or chute in the underside of the fuselage nose.

If the Stratojet lives up to the M of 0.95 predicted by the model tests, its top speed at 35,000ft will be 630 m.p.h., and if the sea-level static thrust rating of 24,000 lb drops off in the normal manner, it packs enough power to reach that speed at the tropopause. The maximum sea-level speed is probably over the 600 m.p.h. mark. With the assistance of two batteries of nine 1,000-lb JATO rocket units on each side of the fuselage just aft of the wing, providing an extra boost of 18,000 lb thrust for 2.8 seconds, the resulting take-off and initial climb is quite spectacular, especially for a bomber. Concerning which, it might be noted that as the normal gross weight is 125,000 lb and the wing area only about 1,400 sq ft, a wing loading of nearly 90 lb/sq ft would present quite a ticklish take-off problem without some form of boost assistance. With overload, the JATO installation has even more significance.

There is widespread confusion concerning the range performance of this aircraft, since it has been publicized as having a range of 2,000 miles with a fuel capacity of 15,000 U.S. gallons. Independently, both these figures may be correct, but they cannot possibly be related, for even a six-jet bomber is hardly that thirsty; moreover, such a short range is clearly unrelated to the bombing functions of this design. With a fuel tank stretching all the way back from the cockpit to the rear wheel housing (a length of about 50ft), it is just possible to pour in a tankage of 15,000 U.S. gallons, but as this amount of kerosene weighs slightly over 100,000 lb, it is palpably obvious that it cannot be associated with a normal gross weight of 125,000 lb. Carrying a bomb load of 22,000 lb and full tanks, the overload gross weight could not be much less than 190,000 lb, a figure which hardly seems feasible at this stage of development.

Assuming, therefore, a more reasonable overload weight of 155,000 lb and a reduced tankage of 10,000 U.S. gallons, the maximum range with a bomb load of 22,000 lb can be stretched to 5,600 miles, flying up the hill from 23,000ft to 46,000ft at a nearly constant cruising speed of 465 m.p.h. (Rigorously speaking, for optimum range, the cruising conditions change at the tropopause: the cruising speed increases slightly up the tropospheric part of the incline from 23,000 to 35,000ft, after which it remains constant throughout the stratosphere from 35,000 to 46,000ft.) Once again, then, we see the clear-cut implication of flying fast and high in future jet bomber design.

Because range performance is essentially the crux of future jet bomber design, a final speculation may be worth pursuing in relation to the large tankage built into the XB-47. From the impressive JATO rocketry, which is an integral design feature of this aircraft, it is not too rash, perhaps, to forecast that the normal gross weight of 125,000 lb will be gradually increased by successive structural stages until the full tankage of 15,000 gallons is ultimately reached. As intimated above, the overload gross weight in this condition is estimated at 190,000 lb. (The corresponding wing loading of 136 lb/sq ft is a bit frightening and may take some explaining away!) When, and if, this stage is reached, the bigger J-47 5,000-lb turbo-jet will be ready for the production B-47 airframe, and one begins to see where the large tankage fits into the projected design picture.

An idea of the long-range possibilities now clearly showing over the horizon can be evaluated in terms of range mileage by assuming that the J-47 engine can be cruised at 75-80 per cent of its normal 5,000-lb thrust rating. (This cruising ratio is somewhat higher than current American ratings, but appears to be a reasonable trend in view of British practice.) On a gross weight of 190,000 lb, our slide-rule shows a maximum range of 8,500-9,000 miles with a bomb load of 22,000 lb, and a cruising speed of 560-570 m.p.h., mostly in the stratosphere; indeed, since the final cruise altitude reaches 52,000ft, the pressurization problems of jet bomber design are going to be closely interwoven with the cruising economics.

Whittling Down the Future

Looking down the fourth dimension, say up to 1952, the mainstay of U.S.A.F. strategical bomber groups must depend largely upon the piston-engined Boeing B-29 and B-50 (and, possibly, the compound-engined B-54) for medium ranges in the 4,000-6,000-mile category. It is clear, however, that the bomber spectrum is shifting rapidly to the top right-hand corner of the performance chart; in the realm, that is, of 500 m.p.h. cruising speeds and stratospheric altitudes up to 50,000ft. It follows, therefore, that the piston-engined bomber is going to be outclassed in the medium ranges by the pure jet types, as already evidenced by the Northrop B-49 and the Boeing B-47. Further, for short-range tactical bombing, there can be little doubt that the North American B-45 will replace existing piston-engined types and hold the field for some time, since its present performance can be stepped up by remounting with the J-47 engine.

The real question-mark of the future is the long-range bomber in the 8,000-10,000-mile bracket—the proposed sphere, that is, of the Convair B-36. We have already discounted the Flying Stick as too slow and vulnerable—with a very "soft underbelly" should the range be pushed to 10,000 miles carrying a parasite fighter and extra fuel tanks in the bomb bay. The B-36B, incidentally is reported being groomed for a stunt flight of 12,000 miles under these highly unrealistic combat conditions. The military planners of to-morrow's Air Force now stand at the signpost faced with a momentous decision—whether to take the middle road of the compound and turboprop, or to raise their sights and go boldly out for an all-jet bomber force.

Technically, at any rate, this writer is satisfied that the reflection in the range-finder is focused clearly on the turbo-jet engine—just as Sir Frank Whittle himself prognosticated several years back. Our own range-finder—as seen through the hair-line on a slide-rule cursor—shows that the jet bomber is essentially a stratospheric combat weapon and must be strictly tailored to that specification, along with the rest of the airframe. While it will be some time yet before the all-jet bomber Air Force becomes an operational reality in the U.S.A. rearmament scheme, both the Northrop B-49 and the Boeing B-47 look capable of logical development through their present medium-range status to that of long-range strategical bombers.

Whether the shape of wings to come will take an arrow or a trapezoidal geometry is yet too early to say, and so it is obviously a sound plan to strike out in both directions. In spite of the orthodoxists, however, the all-wing layout looks a logical trend, since by lengthening the root chord in successive stages one arrives step-by-step at the delta configuration. One thing is tolerably certain—the propeller will have no place in the fighter and bomber forces of the future. In keeping with the rest of the airframe, the windmill is being neatly tucked inside and whittled down to a row of turbine blades. Why defeat the elegant simplicity of Whittling by churning up the airflow again with windmills?

PERFORMANCE COMPARISON: AMERICAN JET BOMBERS

Aircraft: (Power Plant)	Gross Weight (lb)	Speed at Altitude		Initial Climb (ft/min)	Service Ceiling (ft)	Bomb Load/ /Range (lb/miles)
		Maximum (mph/ft)	Cruising (mph/ft)			
North American B-45 (4 GE-Allison J-35)	82,600	530/35,000	410/24-47,000	2,550	38,000	20,000/2,200
Boeing XB-47 (6 GE-Allison J-35)	125,000 155,000	630/35,000 580/35,000	475/31-46,000 465/23-46,000	2,950 2,200	40,000 35,000	22,000/3,700 22,000/5,600
Northrop YB-49 (8 GE-Allison J-35)	220,000	480/35,000	400/27-47,000	1,850	38,000	30,000/5,400

Notes.—(1) Service ceilings are based on initial gross weight at take-off; actual target ceilings are higher. (2) Initial climb of XB-47 does not include JATO boost of 18,000 lb. (3) Gross weight of YB-49 is currently reported at 213,000 lb., but resulting difference in range performance is negligible, since computations were based on a more conservative specific fuel consumption than the cruising values quoted by engine manufacturer.

Corporations' Annual Reports

Heavy Losses Continue, but Overall Picture and Outlook Brighter

ALTHOUGH the accounts of the three airline Corporations for the financial year 1947-1948 show a 5 per cent greater loss than in the previous year, amounting to £11.09 million as compared with £10.57 million, the overall picture is much more encouraging than at this time last year. During the twelve months under review, 100.4 million capacity ton miles were flown on air transport services compared with 73.4 million capacity ton miles in 1946-7, and 471 million passenger miles were flown by comparison with 338 million. These figures represent a 37 per cent and a 42 per cent increase respectively. Total operating costs for the year, in fact, fell from 76.4d to 68.5d per capacity ton mile for the three Corporations. The results of the vigorous efforts of the Corporations to cut down expenditure, which have been and are still being made, will not be felt appreciably until 1949-50, but there should be a progressive improvement from then onwards. The principal improvements will come from the cutting down of indirect costs, and the bringing into service of more economical types of aircraft.

Losses for the period under review were:—

British Overseas Airways: £7,091,439 (£8,076,844 loss in 1946-7). British European Airways: £3,573,989 (£2,157,937 loss in 1946-7). British South American Airways: £421,481 (£20,507 surplus in 1946-7).

A large number of contributory causes for their continued losses are mentioned by the Corporations in their three individual reports. Some are in process of removal, but others will continue for at least two or three more years. They include multiplicity of aircraft types, development and introduction of new types, development of new routes, delay in introducing new aircraft, inadequate and uneconomical maintenance and housing facilities, priority bookings, high landing fees at home, duty on fuels, and training of crews and administrative staff. Three other subjects which also have a bearing on finances and are at present under negotiation, are arrangements for the carriage of mail, the general pensions scheme to be set up for the three corporations and an incentive scheme for engineering personnel.

B.O.A.C.

DURING the year route mileage for the Corporation increased from 53,998 to 58,318; aircraft mileage from 27,537,849 to 29,193,057; capacity ton miles from 59,258,901 to 65,635,148; and operating revenue from £11,459,734 to £12,292,403.

Services are operated with substantially the same aircraft as in the previous years because of delays in the delivery of Solents and Stratocruisers, and maintenance had still to be done at scattered bases remote from the terminal airports. Thanks to the changes made to secure higher payloads and operating economies, the direct operating costs were reduced from 44.6 to 39.7 pence per capacity ton mile; the Atlantic Division achieved 28.1 pence per capacity ton mile. The total operating costs fell from 76.2 to 69.7 pence per capacity ton mile.

During the year there was a continuous reduction in the number of staff from 24,464 to 21,844. The output of capacity ton miles per employee, which is a measure of efficiency of airline operation if conditions remain the same, rose from 2,422 to 3,005. In the Atlantic Division the output was more than twice as large as the average.

Outstanding features of the work of the Divisions have been the high utilization of the Constellations in the Atlantic Division, the interference with the services in North Africa and the Middle East owing to the outbreak of cholera and the troubles in Palestine, and the remarkable success of Operations India and Pakistan. At very short notice the Corporation, working in co-operation with the charter companies, organized two air lifts which together carried 43,500 people and 670 tons of baggage without an accident.

In spite of substantial progress made there was again a heavy deficit of £7,091,439, which compares with £8,076,844 for last year. The main causes were the multiplicity of types of uneconomical aircraft still in use and the high cost of maintenance due to the number and location of maintenance bases.

Future Aircraft Programme

The uncertainty about the future aircraft programme, which had made it extremely difficult to plan ahead, is now removed. Five Constellation have been bought for the Australian service, twenty-two Canadairs have been ordered, and the Hermes IV should be in operation on the Empire routes in 1949-50. The re-equipment of the fleet with these aircraft will change entirely the Corporation's financial prospects, and with the economies made possible by the reorganization now in progress, the Corporation should be self-supporting on its commercial routes within three or four years.

There are still two difficult years to face in 1948-49 and 1949-50, as exceptional efforts and costs will be involved in bringing into service the new types of aircraft. The move of the Dorval base to Filton is a costly disruption. Much of the abnormal expenditure will not be fully productive until 1950-51.

Activities of the Corporation during the year have included the opening of a new service from the U.K. to Colombo and later its extension to Singapore, and the extension of the U.K.-Hong Kong service to Iwakuni, Japan. Australia and South Africa services, operated in partnership with Qantas Empire Airways and South African Airways, have shown substantial increases in traffic. Improvements have been made in both the transit and night stop accommodation along the routes. The cost of providing this accommodation is heavy at the seventy stations at which the Corporation has to maintain staff. The reservation of rooms all through the year to be certain of the accommodation is an expensive item in the cost of the services. Progress has been made in developing precooked frozen food.

The Corporation continued the policy of assisting the airline companies along its routes and of taking a financial interest in such companies where desirable. Hong Kong Airways has been formed as a wholly owned subsidiary, with the intention of inviting participation by local capital, and the Corporation has taken a small interest in Malayan Airways.

Service Staging Posts Taken Over

Responsibility of providing communications, flying control and navigational facilities at a number of stations along routes following the withdrawal of R.A.F. staging posts, has been transferred to International Aeradio, Ltd., the subsidiary formed for the purpose in 1947 by the three Corporations.

The Technical Development department has been closely associated with the firms producing the Hermes IV, Bristol 175 and de Havilland Comet to ensure that future operational requirements of the Corporations were considered at every stage. The Corporation has also been associated with the building of the S.R.45 and Brabazon I.

In January, 1948, the Boeing 314 flying boats were withdrawn from service on the Baltimore-Bermuda route and were replaced by Constellation aircraft operating to Bermuda both from New York and Baltimore.

In July, 1947, the Corporation purchased a secondhand Constellation for $131,000 (£34,725). After preliminary work in California the aircraft was flown to Dorval where the modifications required to bring it up to B.O.A.C. standards were completed by March, and the aircraft was in service in April, 1948. Thanks largely to the skill of the staff at Dorval the total cost was $459,000 (£114,725), which is less than half the price of a new aircraft of this type. During August, 1947, modifications were completed to increase the all-up-weight of Constellation aircraft from 90,000 to 93,000 pounds with consequent improvement in payload.

Plans have been made for the move of the Atlantic Division Base from Dorval in Canada to Filton. The object of this move is to save dollars, but it will involve the Corporation in heavy expenditure, much of which would have been avoided if accommodation had been available at London Airport. The capital cost to the Corporation will be at least £400,000, which includes £250,000 for the construction of workshops and offices

and approximately £100,000 for the provision of airfield lighting and radio aids. It has been necessary to make special arrangements for housing staff in the Bristol area. The incidence of this expenditure is especially heavy in view of the relatively short period which will elapse before the maintenance base is moved to London Airport.

Regarding traffic, the principal variations contributing to the increase of over 6 million capacity ton miles were:

INCREASES

	1946-47	1947-48	Increase
North Atlantic	7,565,000	12,273,000	4,708,000
U.K./Australia	7,334,000	11,124,000	3,790,000
U.K./Far East	1,847,000	5,280,000	3,433,000
U.K./India and Malaya	13,345,000	14,246,000	901,000
U.K./West Africa	3,005,000	3,912,000	907,000
U.K./East Africa	nil	818,000	818,000
U.K./South Africa	4,801,000	5,731,000	930,000
Charters	639,000	1,740,000	1,101,000
TOTAL			16,588,000

DECREASES

	1946-47	1947-48	Decrease
Horseshoe Route	5,983,000	Nil	5,983,000
U.K./Middle East	7,191,000	5,924,000	1,267,000
Middle East (Local) ..	3,212,000	2,428,000	784,000
European Routes	2,207,000	Nil	2,207,000
TOTAL			10,241,000

Total load ton-miles on scheduled services increased by 11.7 per cent, passenger load ton-miles by 6.7 per cent, while largely due to the increased free baggage allowance on long-distance routes, excess luggage showed a decrease of 33.4 per cent. Passenger revenue amounted to 55.3 per cent of the total revenue and passenger ton-miles 66.5 per cent of the total load ton-miles. 101,901 passengers were carried during the year as compared with 97,603 for the previous year, but in 1946-47 32,325 were carried on services now operated by B.E.A.

Mail ton-miles increased by 20.1 per cent, and mail revenue amounted to £3,582,135, or 29.1 per cent of the total traffic receipts. Air freight load ton-miles increased by 56.9 per cent and air freight revenue from £553,824 to £687,539.

Towards the end of the fiscal year, due to competition, passenger logs disappeared on practically all routes. It became, therefore, increasingly difficult to dispose of seats reserved for the Priorities Board which were frequently returned at short notice. Revenue was thus adversely affected by an estimated amount of £122,000. Priority reservations have, however, been reduced during the year from 43 to 10 per cent outbound and 29 to 3 per cent inbound.

Co-operation with the British Air Charter Association had mutually satisfactory results. Flights sub-contracted to B.A.C. members by the Corporation resulted in their earning £435,840. 115 other charters to U.K. operators produced additional revenue for them of £187,000. The handling of charter and other operators' aircraft along the Corporation routes resulted in a revenue of £285,809 applied to the accounts in reduction of station costs.

Multiplicity of types continued; in 1947 the fleet was 175 aircraft, including training types, the main operating fleet comprising 130 aircraft of nine different types. In March, 1948, the total strength was 148 aircraft, with an operating fleet of 126 of seven different types. With the exception of the Constellations, the majority of the fleet continued to be composed of obsolescent aircraft.

Capital commitments for aircraft and engines under construction include six Boeing Stratocruisers costing £2,549,892 and 25 Hermes IV and 25 D.H. Comet aircraft. The conversion costs of the Plymouth aircraft were £88,830. During the next two years the Corporation will withdraw six types of aircraft from service and replace them with new ones.

During the year two fatal accidents to aircraft on regular service caused the death of seven passengers and injury to nineteen. In addition, ten crew members were killed and eight injured. The Corporation's aircraft flew 296,900,000 passenger miles. The accident ratio was, therefore, less than one passenger fatality for 42,800,000 miles flown. This represents almost exactly twice as many passenger miles flown per fatality as was recorded by all international airlines together for the year 1947.

During the year, 302 conversion courses were completed, 463 aircrew—152 pilots, 109 navigators, 97 radio officers, and 105 engineer officers—received training, and 78 First Officers received Command Courses, 24 being up-graded from Co-pilot to Captain.

Reports on the Corporation's associates and subsidiary companies are contained in the annual report and statement of accounts. The companies concerned are: Aer Lingus Teoranta (share of loss £79,000); Malta Airways; Iraqi Airways; Eagle Airlines, Iran; Aden Airways; East African Airways Corporation; West African Airways Corporation; Orient Airways, Pakistan; Malayan Airways; Hong Kong Airways; Tasman Empire Airways, Ltd.; British Commonwealth Pacific Airlines; International Aeradio, Ltd.

The deficit for the year on Operating Account amounted to £6,503,166 compared with £7,258,190 for the previous year. The deficit on the operation of scheduled services amounted to £6,567,741 which was incurred by the Divisions as follows:

African and Middle East Division ..	£3,032,479
Eastern Division	2,889,657
Atlantic Division	645,605
TOTAL	£6,567,741

A profit of £103,279 was made on non-scheduled services, which represent flights operated on charter to the public or to governments and regular services operated on a charter basis for certain associated companies.

(B.E.A. and B.S.A.A. reports will be published next week.)

TURBOJETS SUPPLIED TO RUSSIA

A QUESTION was asked in the House last Monday afternoon, November 22nd, regarding the number of turbojets supplied to Russia. The Minister of Supply, Mr. George Strauss, said in reply that the Rolls-Royce company was given permission in September, 1946, to sell ten Nenes to Russia, and in March, 1947, to sell a further fifteen. None had been sold to Czechoslovakia or any other country which could be described as under Soviet influence, and no further sales were contemplated. In answer to a further question, it was stated that in all 55 such engines were supplied to the Soviet Union during 1947 and that one reason that no further sales were contemplated was that we had received no enquiries. Mr. Strauss added that none of these engines was on the secret list.

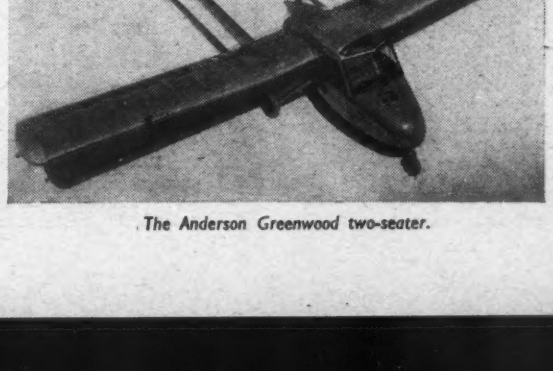
EAST AFRICA CONNECTIONS

HUNTING AIR TRAVEL have announced that they have recently signed a contract to provide facilities for flying passengers between London and East Africa for the Overseas Food Corporation. Five Vikings of Hunting's fleet based at Bovingdon are used and flights have already begun. The normal East Africa terminal is Dar-es-Salaam or Lindi, 220 miles further south, and night stops are made at Malta and Khartoum. A regular flight starts from Bovingdon every Wednesday and from Dar-es-Salaam every Saturday morning, making a three-day schedule each way. Most of the passengers are wives and families of the Corporation's employees.

LIGHT PUSHER FROM TEXAS

A NEW name among American light aircraft manufacturers, Anderson Greenwood and Company, of Sam Houston Airport, Texas, have introduced a two-seater twin-boom pusher design with, by report, some promising features. It is of all-metal construction and the wing is at shoulder level. The Continental C-90 flat four engine is mounted in the top surface of the wing centre-section and cooling air is scooped from below the wing root at the leading edge.

Well-known advantages of this pusher-type layout are the car-easy entrance and exit; "protected" airscrew, spacious cockpit offering an excellent view, and low noise level. Baggage space is provided behind the seat, radio is built in and the nose wheel is steerable from the control wheel.



The Anderson Greenwood two-seater.

Discussing the Helicopter

All-day Joint Meeting of the Royal Aeronautical Society and the Helicopter Association of Great Britain

LAST Saturday was a strenuous but interesting and fruitful one for aircraft technicians. The Royal Aeronautical Society and the Helicopter Association of Great Britain held an all-day meeting at the Institution of Civil Engineers. Altogether five papers were read, two during the morning and three in the afternoon, and there were discussions after the papers as well as a longer one in the evening.

The two morning papers dealt with the general problems of the helicopter for civil use. W/C. R.A.C.Brie, A.F.R.Ae.S., stated the operational point of view, while Capt. R. N. Liptrot, C.B.E., B.A., outlined the technical problems of the civil helicopter.

The afternoon papers were designed to state the constructors' approach to the problem. J. A. J. Bennett, D.Sc., M.A., D.I.C., F.R.Ae.S., F.Inst.P., stated the case for the Gyrodyne. Raoul Hafner dealt with the solutions incorporated in the Bristol 171, and J. S. Shapiro, Dipl. Ing. A.F.R.Ae.S., described the Cierva Air Horse and explained the considerations underlying its design.

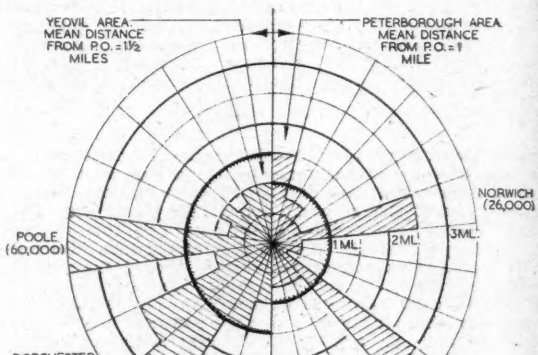
THE OPERATIONAL POINT OF VIEW

WING COMMANDER BRIE, who is in charge of the B.E.A. Helicopter Unit, recalled that over a recent period of nine months, covering more than a thousand hours of experimental and scheduled operation, there was on no occasion a cancellation or interruption of flight due to the failure of any purely helicopter component. It had been proved that there is no fundamental deficiency in basic configuration, and that difficulties that had arisen could be attributed to lack of refinement in detail design.

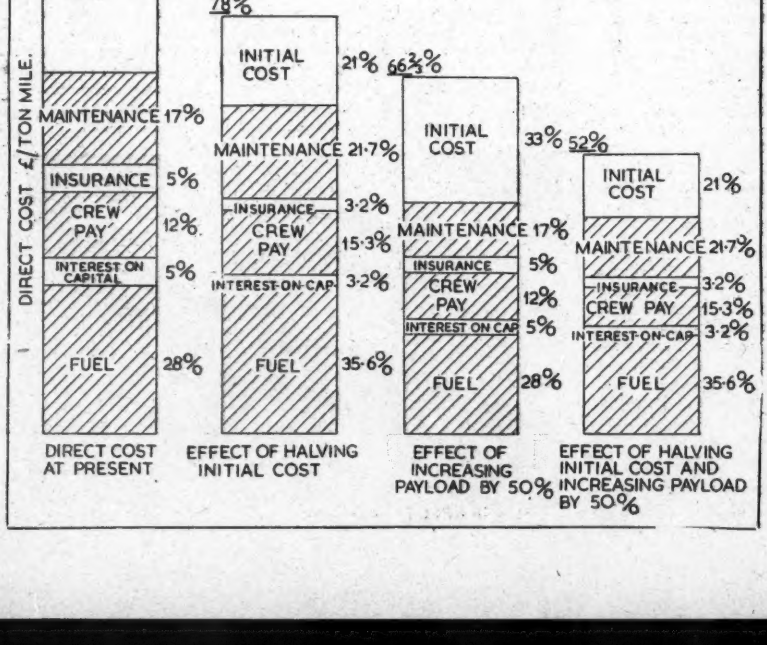
On the engineering side, he pointed out that the helicopter as a whole was particularly susceptible in terms of frequency and amplitude, to quite small departures from allowable tolerances on linkages.

At present the working life of main rotor hinge bearings was too limited. Compactness had been achieved at the expense of reliability, comfort and performance. Cost of operation was increased not only through the enforced servicing, but by the interruption in the working life of other components which would best function if left alone. Ideally, all components should have a stated life, their replacement and interchangeability being of primary importance. In addition, the design layout should be such as to allow concentrated effort to be applied, thus reducing turn-round time.

Accessibility demanded easily removable panels, jacking and hinge points, hand grips and foot rests. Suppression of friction demanded adequate lubrication, and if a grease gun was to be used, correct positioning of the connectors was important.



Distances from post offices to helicopter sites in Yeovil and Peterborough areas.



Factors affecting direct flight cost. 5,000 lb helicopter, 1,000 hr utilization.

Sound engineering practice during initial design was vital.

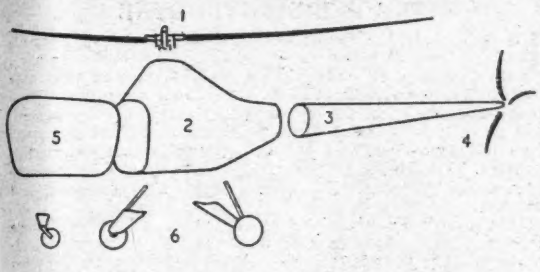
W/C. Brie admitted that although it was sometimes said that the helicopter is not difficult to fly, it would be an exaggeration to suggest that it is easy. The efficiency of the control system was to some extent offset by the delicacy required in the co-ordination of individual controls, lack of uniformity in sensitiveness and "feel," and the inability to trim for any prolonged period. Lack of a satisfactory trimming device for use during flight necessitated the employment of the azimuth control, thus restricting adequate control response to gusts, and adding to difficulties of night and blind flying.

The psychological aspect of helicopter pilotage needed to be explored, for the mental capacity to think might not always be in step with the physical necessity to act.

Operating from confined areas demanded rapid rate of climb at a steep angle and slow rate of descent at low forward speed. These requirements were functions of power and disc loading respectively, the desirable values of which should not exceed 10 lb per h.p. and 2 lb per sq ft respectively.

For safety the view from the pilot's seat must not be impaired by the external effect of rain or by internal misting. This was particularly important during night and blind-flying operations at low altitude.

Discussing the Helicopter . . . . .



Component man-hour breakdown (major inspection) for a helicopter. 1, main rotor system (50); 2, centre fuselage (61); 3, rear fuselage (4); 4, tail rotor system (11); 5, front fuselage (2); 6, undercarriage (2).

For operation over densely populated centres, mountainous terrain and water, he thought a twin-engined installation was obligatory, an essential requirement being maintenance of height in the event of partial power failure.

W/C. Brie advocated the development of instrumental and navigational aids. Only by the ability to fly blind and at night would maximum utilization be attained. The accurate identification and use of small landing areas also involved the development of suitable ground lighting equipment.

At present the economics of helicopter operation were such as to preclude consideration of other than highly specialized uses. This limitation arose from high initial cost and low payload capacity.

It was not difficult to increase payload for freight or mail purposes, but for passengers the picture was different. A preliminary study, however, indicated the possibility of reducing cost per passenger mile with helicopters of 12-14 seats.

W/C Brie concluded by saying that the stage of development already reached indicated a need for boldness and enterprise in making the best use of knowledge which already exists, rather than in scanning for fresh horizons, with their inevitable uncertainties. The helicopter had already arrived in practical form, and its further development was closely associated with a solution being found to many relatively small, but nevertheless important, problems.

TECHNICAL PROBLEMS

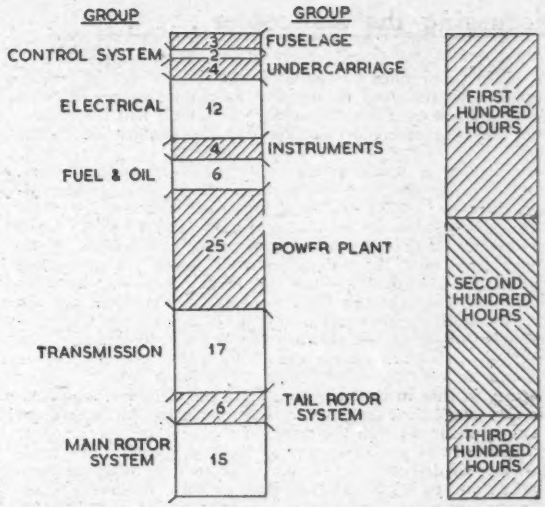
CAPT. R. N. LIPTROT pointed out that the types of helicopter on which present experience is based were born in the stress of war, when they had to be put into use as soon as they worked reasonably well. It had to be admitted that in many respects they were relatively crude in design, but they had demonstrated the helicopter as a practical transport vehicle.

A critical examination of the helicopter problem and the characteristics of available types disclosed the following special problems for investigation during the next stage of development: vibration, simplification of control, stability, safety and maintenance.

Capt. Liptrot recalled that the dissymmetry of lift on opposite sides could only be corrected by a periodic change of the lift and drag forces. The classic solution was the flapping blade introduced by de la Cierva, which not only balanced-out the dissymmetry of lift but relieved the blade roots of periodic bending moments. The solution was elegant, but instead of relieving the vibration problem, it accentuated it. The longitudinal flapping due to forward motion resulted in a tilt of the tip-path plane, and in addition the tip-path plane had to be tilted by some form of periodic control in order to trim the aircraft. There was, therefore, dissymmetry in the plane at right angles to the axis of rotation.

In addition, a flapping blade was subject to a Coriolis acceleration in the plane of rotation. As a blade flapped upwards the distance of the centre of mass from the axis of rotation decreased. For constant r.p.m. the product of this distance times the angular velocity must remain constant, so that the blade had to accelerate as it flapped upwards and decelerate as it flapped downwards.

These two dissymmetries made a drag hinge necessary. The drag hinge, however, led to further trouble, in that an unstable hunting oscillation was caused, unless the freedom of movement of the blade about the drag hinge was restricted by damping.



(Left) Ratio of defects in various helicopter groups, over 300 hours flying. (Right) incidence of overall defects, over 300 hours flying.

As the ratio of forward speed to rotational speed increased, the retreating blade was more and more stalled, again causing vibration.

When forward motion was obtained by tilting the tip-path plane, there was added axial flow through the disc. This reduced the effective angle of the blades, and as the collective pitch was increased to maintain the average lift, the tip sections were overpitched and periodic stalling occurred.

In forward flight, Capt. Liptrot continued, the helicopter engineer had a veritable witches' cauldron of fluctuating forces and a vibration problem which, though it might delight the heart of a vibration engineer, was one of the main headaches for the poor designer. He thought vibration rather than compressibility effects might be the major factor in limiting the top speed of the helicopter.

Some designers had considered it was sufficient if vibration was isolated from the aircraft. He did not agree with this, because, even if vibration was isolated, it was still there, and would promote fatigue failure. He personally, as one who persisted in flying helicopters, wanted to feel any vibration that might be present, so that should it increase, he would know that something was wrong.

On the subject of simplification of control, Capt. Liptrot pointed out that the helicopter required one additional control compared with fixed-wing aircraft, i.e., the collective pitch control. It had become common practice to operate the collective pitch and throttle by one hand, and it had been in the correct co-ordination of these two that the pilot had found difficulties. In the classic helicopter configuration (single main rotor with torque compensating tail rotor) there was the further difficulty that use of one control demanded co-ordinated adjustment of the others.

Capt. Liptrot had stressed the difficulty of control because it was very real, but actually this was only in the early stages. Once the pilot got the hang of the thing, he could relax a little and flying became relatively simple. However, in the next generation of helicopters the controls must be simplified and some of the co-ordination done for the pilot by some mechanical device.

With increasing use of the helicopter it would become necessary to cater for more adverse weather conditions, especially where a rigid time schedule was demanded. Intrinsically, the helicopter was the safest of all flying machines in low visibility, but under blind conditions, when the pilot had to give his whole attention to navigation, radio, etc., stability characteristics which might be acceptable under contact conditions became insufficient. It was important, therefore, that designers should give improved stability, certainly under normal cruising conditions, and preferably under any conditions of flight, including hovering.

Capt. Liptrot, deliberately threw out a challenge to designers by saying that in the event of power failure the helicopter was converted into an Autogiro by pitch reduction and could make a safe forced landing into a small space exactly like the Autogiro. There was the difference, however, that in the helicopter

Discussing the Helicopter . . . . .

the blade pitch must be reduced rapidly. For this reason, coupled with the need to simplify the co-ordination of pitch and throttle, some form of constant-speed unit had been advocated, so that emergency action was not required from the pilot.

He uttered a warning concerning constant-speed devices. Most of those proposed followed the lines of the constant-speed airscrew: a governor operating direct on collective pitch. These devices were not satisfactory; they introduced a hazard of their own in that in the event of power failure close to the ground they took the wrong remedial action. Under these conditions the collective pitch should be increased, so using the kinetic energy of the rotor to arrest the landing. On the other hand, if the governor operated on the throttle while co-ordination of pitch and throttle was done automatically, the collective pitch lever became the pilot's master control, and he still had to decrease pitch manually. There was a further difficulty in that in the helicopter state the airflow through the disc was from above downwards, whereas in the Autogiro state it was upwards through the disc. If engine failure occurred at low airspeeds, it was necessary to pick up speed to get minimum rate of descent on the glide. To pick up airspeed from hovering and to establish a new flow pattern, the average loss of height was about 300ft, decreasing with increase in airspeed. This was the one real potential hazard with the helicopter. If the single-engined helicopter was to be permitted to operate over built-up areas, it would be essential to remove this potential danger.

Maintenance

Of maintenance Capt. Liptrot said that it was the maintenance cost, due to direct labour in short inspection and overhaul periods, the excessive requirement of replacement parts and the lost time due to unserviceability, which had damped the ardour of the most enthusiastic. Frequent dismantling and inspection were worth while while experience was being gained, but that time was past, and in too many existing designs the maintenance crew was faced with an exceedingly complicated mechanism which it was over expensive to take down and inspect. He quoted as an example the transmission of the cyclic pitch control from a swashplate to the blades. Too many parts were used, and this motion could far better have been transmitted by a single link, thus increasing life between overhauls and cutting down expensive replacements.

The small angular movement in ball and roller bearings caused friction, oxidation and short bearing life, compared with a normal fatigue failure of the same bearing for single-direction continuous motion. It was only by reducing the load rating to about one-third of the unidirectional that one could get a satisfactory life. This phenomenon had not been generally realized by helicopter designers who had chosen their bearings on the makers' normal ratings. Failure of universal joints was another fruitful cause of unserviceability. Research and development of bearings which would give longer life under oscillating motion at small amplitude was urgently needed.

Most present-day helicopters were characterized by the complete inaccessibility of their power plants. Engines were enclosed in cooling-air ducts and completely boxed-in by fire walls, and close to fuel tanks. There had been cases where fuel tanks had to be removed to enable plugs to be cleaned. Maintenance under such conditions was difficult, and the designer would have to do better in future.

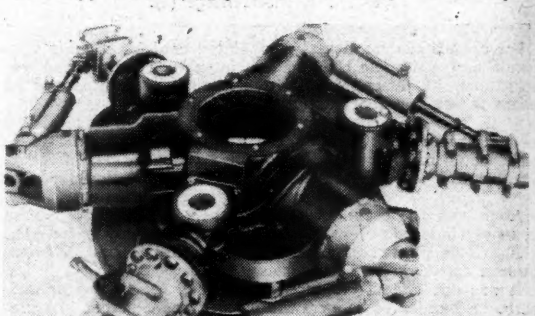
The Fairey Gyrodyne holds the world's speed record for helicopters with 124.3 m.p.h. The flights were made in very bad weather.

THE FAIREY GYRODYNE

IN his lecture Dr. Bennett pointed out that de la Cierva's simple type of rotorcraft was developed to the stage when it could take off and land vertically, and that thus only the ability to hover remains as the unique advantage of the power-operated rotor, an advantage for which a heavy penalty has to be paid. The general problems of the helicopter for civil use were concerned mainly with an alleviation of this penalty. The ability to hover could be bought at the expense of simplicity of control, safety, compactness of design, and comfort.

In the design of the Gyrodyne an attempt had been made to regain some of the ground that was lost. The propulsive powered rotor and the autorotative rotor represented two extreme forms of rotary-wing aircraft, and the relatively non-propulsive rotor of the Gyrodyne avoided certain limitations of the two extremes.

Since approximately 95 per cent. of a helicopter's life is spent in forward flight, the Gyrodyne had been designed with its torque-compensation airscrew located laterally, thus doing useful work for forward propulsion throughout practically the whole of its normal operating life. The proportion of power delivered to the rotor decreases with forward speed, and consequently the main transmission need be fully loaded only during take-off and landing. This ensured a high margin of safety at cruising speed. It might be thought that too much power was applied to the airscrew in vertical flight, but this power could be regarded as a reserve, and when necessary the vertical climb could be boosted temporarily by making axial turns.



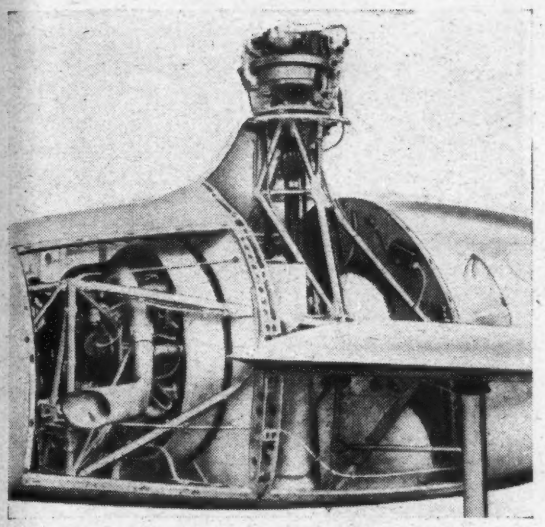
Courtesy of the Helicopter Association

The rotor head of the Fairey Gyrodyne. This is of the tilting type.

It was hardly ever necessary to climb vertically out of the ground cushion, and it was much safer to climb at the forward speed which required minimum power. A steep angle of ascent was of greater importance than a high rate of vertical climb.

As it was unrestricted by rotor blade-clearance problems, the Gyrodyne had a lower disc loading than was possible with most other forms of helicopter. The limiting power loading of the helicopter was almost inversely proportional to the square root of the disc loading. Thus if the disc loading of the Gyrodyne was 20 per cent less than that of other helicopters of equal gross weight, the Gyrodyne could lift the same load for 10 per cent less power. The load sustained per rotor h.p. in the Gyrodyne was probably greater than that of any other helicopter. Similarly, the low disc loading minimized the sinking speed in a glide.

There was a general impression that low disc loading was detrimental to efficiency at cruising speed. This was not necessarily so, because it was blade loading which governed profile power loss. The blade loading could be kept relatively high by using low solidity. In the Gyrodyne the solidity was only 1 per cent per blade, and the blade loading was 75. The high blade loading en-



Courtesy of the Helicopter Association

Installation of Alvis Leonides and transmission in the Gyrodyne.

sured low profile power loss at top speed, and the low disc loading a low induced power loss when hovering.

Low disc loading and low rotor pitch had contributed to the remarkable safety achieved by rotary wing aircraft in the pre-helicopter era. In contrast to most other helicopters, a result of the low-pitch operation of the Gyrodyne was that it could not be stalled under any condition of flight by a possible misuse of the controls. Another advantage of low pitch was that it effectively minimized vibration.

A significant feature of the Gyrodyne was its independent means of propulsion, which enabled both fuselage and tip-path plane to remain substantially level under cruising conditions. This removed an important barrier to the propulsion of helicopters. Periodic lift distribution in autorotative rotors had resulted in stalling a part of the retreating blade near the root, but in the helicopter with forwardly-inclined rotor, periodic stalling could occur at the blade tip. Operation of the helicopter close to the periodic stall of the retreating blade was limited by vibration. No matter how much power was available, it could not be utilized for propulsion beyond the periodic tip-stall barrier. As higher-powered helicopters became available, the feature of independent propulsion would become more and more essential. Many sources of vibration were inherent in rotary-wing aircraft, but the periodic tip stall was one which *could* be avoided. Continuity of operation in adverse weather could only be ensured by ability to maintain a high cruising speed.

With the change-over from the autorotative to the powered rotor, the simplicity of control had deteriorated. The number of controls had increased from two to four, and the ever-present necessity for torque balance and pitch-throttle synchronization required the four controls to be operated simultaneously. This was a further penalty that had to be paid for the ability to hover.

In the Gyrodyne an attempt had been made to minimize this penalty by suppressing one control. The only flight controls were the stick, the throttle and the pedals. Collective pitch was automatic by giving the drag hinge a slight downward and outward inclination. Thus there was an immediate increase in manifold pressure whenever the throttle was opened, without any appreciable change in angular speed. An over-riding control had been designed but not yet fitted. This was mainly for trimming at altitude, but could also be used for momentary hovering before making a power-off landing. The device operated additional hinges, which were locked in normal flight.

The Gyrodyne design also eliminated the usual torsional bearings. Instead of a swashplate, the rotor head itself formed the swashplate. This did not mean that the hub axis was tilted, but instead, the hub axis (the axis of the main bearings) remained fixed, and the rotor head was tilted relative to the hub axis. In forward flight the forward inclination of the head balanced the backward inclination of the tip-path plane, which therefore remained substantially at right angles to the hub axis.

Stick shake was completely eliminated by the use of hydraulic irreversibility. Steady loads had also been suppressed hydraulically, but it was now thought advisable to retain the steady loads, which provided a natural "feel," and to use hydraulic irreversibility only for suppressing stick shake and as a precaution against misuse of the controls by violent handling. An electrically operated actuator was used for controlling the rate of clutch engagement, and Dr. Bennett thought that a torque-limiting device ought to be an essential airworthiness requirement.

In describing the construction of the blades of the Gyrodyne, Dr. Bennett explained that the blades were of accentuated flexibility in bending but rigid in torsion. The steel tubular spar is of circular section at the root, but for most of its length it is of oval section. The profile is maintained by wooden ribs of plywood skin, the ribs being friction-clipped to the spar.

As the Gyrodyne was designed for transport at cruising speed, a tailplane and two side fins were provided. No attempt had been made at providing dynamic stability at zero forward speed. Dr. Bennett also pointed out that the stub wings of the Gyrodyne have a stabilizing effect in roll, where rotary-wing aircraft tend to be too sensitive.

Designed as it is for high cruising speed, the Gyrodyne, Dr. Bennett said, is best adapted for fairly long non-stop journeys, such as from city centre to city centre, rather than from city centre to airport.

THE BRISTOL 171 HELICOPTER

CONFINING himself to points raised by W/C. Brie and Capt. Liptrot, Mr. Raoul Hafner explained how the various problems had been attacked in the design of the Bristol 171. He dealt with the subjects of vibration, controls, stability, safety, and capital and maintenance costs.

Vibration was a fundamental symptom in rotating-wing flight. It could not be eliminated, but it *could* be reduced to generally acceptable proportions. Because the factors governing blade feathering were complex, the feathering motion could not be expressed mathematically in a simple form, but only by an infinite Fourier's Series. The conventional rotor control, which provides a simple sinoidal incidence-variation during rotation, satisfied the theoretical requirements to a fair degree at low tip speeds. At high tip speeds (high translational speeds) blade lift could not be held constant, and vibration arose. Mechanisms could be imagined which would produce complex cyclic movements, but they would be too complicated, and he regarded the limit of rotating-wing flight as the tip-speed ratio at which higher harmonics become noticeable. Calculations showed that a high tip-speed ratio could only be obtained when the blade was flying at a low basic lift coefficient with an aerofoil section capable of producing a high maximum lift coefficient. To delay shock stall an aerofoil section of low thickness/chord ratio (below ten per cent) was desirable near the blade tip. The rotor flight envelope was defined in the cockpit by a very wide r.p.m. range for landing (this applied to speeds below 35 m.p.h.), a smaller normal r.p.m. range up to speeds indicated on a special scale on the altimeter, and a narrow r.p.m. range applicable up to maximum speed.

Blade drag was mainly caused by blade coning. Even in the 171, with its exceptionally small coning angle, it represented more than 50 per cent of the total mean drag. The drag of all blades added-up vectorially to the total rotor force in the plane of rotation. The greater the number of blades the

The Bristol 171 rotor is characterized by a high moment of inertia in conjunction with an unusually wide speed range. The kinetic energy is 680,000 lb. ft.

Discussing the Helicopter . . . . .

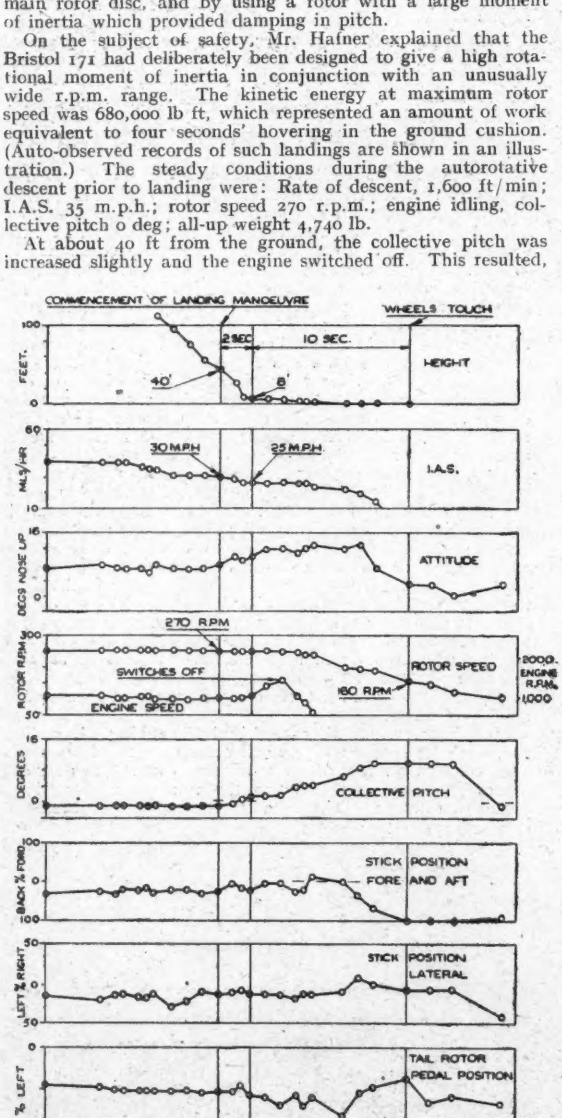
steadier this force. He preferred individual blade articulation over a flexibly mounted rotor, as well as advocating careful mass distribution radially and chordwise, and high torsional stiffness. The ideal blade tapered from root to tip in thickness and plan form, and was of metal monocoque construction.

Mr. Hafner did not think the number of controls could be reduced, but there *was* ample opportunity for simplification in the mechanism of the control circuits; this had been made a fundamental feature in the 171, in the control mechanism of which there were but 27 moving parts. Mr. Hafner pleaded for standardization of cockpit controls.

Referring to stability, Mr. Hafner said there were two types: in forward flight and in hovering. In the 171 there was a fair measure of positive stability in pitch, yaw and roll, and the machine had been flown in gusty air for extended periods without touching the controls. This stability had been achieved mainly by the fuselage carrying a small tailplane outside the main rotor disc, and by using a rotor with a large moment of inertia which provided damping in pitch.

On the subject of safety, Mr. Hafner explained that the Bristol 171 had deliberately been designed to give a high rotational moment of inertia in conjunction with an unusually wide r.p.m. range. The kinetic energy at maximum rotor speed was 680,000 lb ft, which represented an amount of work equivalent to four seconds' hovering in the ground cushion. (Auto-observed records of such landings are shown in an illustration.) The steady conditions during the autorotative descent prior to landing were: Rate of descent, 1,600 ft/min; I.A.S. 35 m.p.h.; rotor speed 270 r.p.m.; engine idling, collective pitch 0 deg; all-up weight 4,740 lb.

At about 40 ft from the ground, the collective pitch was increased slightly and the engine switched off. This resulted,



First of its kind? Auto-observer records of a typical autorotational landing of a Bristol 171 helicopter.

A "compressed" display of the Bristol 171 layout. The tail rotor has been brought in close, and of the blades only the roots are included.

after about two seconds, in a checking of the descent at a height of about 8 ft, and a reduction of forward speed by some 5 m.p.h. During the following ten seconds the machine sank slowly, until first the tail skid and then the wheels touched down. During this period the collective pitch was steadily decreased to 11 deg, the rotor speed dropped to 160 r.p.m., and the forward speed to a walking pace. Apart from an aft movement of the control column at touch-down, all controls remained substantially stationary. These figures showed that with sufficient kinetic energy and good control, an engine-off landing could be made in safety and comfort, even with a heavy helicopter.

Mr. Hafner expressed the view that the high first cost of helicopters is not peculiar to this type of aircraft but is due to the present small market, which does not justify large-scale production. Maintenance costs, Mr. Hafner held, could be reduced by adhering to the following design principles: Mechanical simplicity, and economy in the number of moving parts; fatigue resistance and high life-factors in parts subject to cyclic forces and to wear; accessibility; and interchangeability.

From the illustration of a "contracted" layout of the Bristol 171 the simplicity of the layout could be appreciated. It had been possible, Mr. Hafner said, to design all wearing parts, except tyres, for a life of 7,500 hours without great sacrifice in weight. He hoped that eventually it would be possible to increase periods between overhauls to 1,000 hours, except for the power unit.

Interchangeability had been applied generally in the 171, and at one time it had been thought possible to make the rotor blades interchangeable. That, however, had not been found possible, and blades had to be assembled in rotor sets. If a blade was damaged, there was no need to scrap the other two, which could be paired with others to make new sets.

Mr. J. Shapiro began his Paper on the Cierva Air Horse by recalling that this machine had been called many things, the lowest common denominator of which was "an astounding contraption." He proposed to show in his Paper that it was neither astounding nor a contraption, and he aroused much merriment by saying that, in fact, in the Cierva Autogiro Company they had persuaded themselves that God decreed three-rotor helicopters, all others being merely attempts by men to cheat His divine laws.

The written Paper is a very long one, and Mr. Shapiro had to content himself with reading a summary and by showing but a few of the many diagrams prepared for the complete version, which will be published in the official Journal later. We have not the space to publish a summary this week, but propose to deal with this very interesting Paper in next week's issue. It can be said, very briefly, that Mr. Shapiro's object was largely to show that the undeniable complication of a three-rotor helicopter is worth while if studied in conjunction with the many other aspects that have to be taken into account if one desires to arrive at a sound conclusion.

During the morning session, the chair was taken by the president of the R.Ae.S., Dr. Roxbee Cox. In the afternoon Mr. Marsh, president of the Helicopter Association, presided, and the evening discussion was guided by both.

Apart from the novelty represented by the Air Horse, Dr. Bennett hinted at things to come from the Fairey Helicopter Division. In conjunction with Captain A. G. Forsyth he forecast the possibility of combining jet propulsion with the high forward speed of the Gyrodyne, with the cruising characteristics of the Autogiro, and using jets for vertical ascent.

Ramjet Performance

Part II of Canadian National Research Council Report

(Continued from page 611)

THE second section of the report deals with the combustion processes, and states that all observations on the combustion of liquid hydrocarbons indicate that the visible combustion takes place only at a certain ignition temperature at a measurable velocity and after a given time called the ignition lag.

The fuel injected in the combustor does not immediately react with the oxygen in the air to form carbon-dioxide and water vapour, but highly active intermediate products—atoms, radicals and activated molecules—are formed in the fuel vapour resulting from the heat available in the combustor. These particles, by collision with the oxygen molecules, help to bring about the chemical reaction, whilst the energy released by the collision helps to accelerate the rate of reaction.

Following more closely the physical and chemical processes taking place in a combustor, the course of events is as follows: First, a high-pressure liquid fuel is injected in the airstream. Atomization of the fuel then occurs, the droplets having a velocity relative to the air. Due to friction, heat conduction and radiation from hot gases, evaporation then takes place from the surface of the droplets.

Breakdown Details

It has been shown that the droplets are formed by the continuous disintegration of fragments of the original fuel film which break off irregularly in the form of cords and sheets. The breaking-up region of the film approaches the orifice as the liquid pressure increases. With liquids of low viscosity, the films show considerable oscillations as the pressure is increased. Viscosity, however, damps down these oscillations and retards the breaking-up process. Reduced surface tension results in an increased tendency of the film to form cords at its extremities, which generate into strings of droplets.

Regarding evaporation, it was found that, although the heat of evaporation does not vary much between the different hydrocarbons, the temperature at which this heat must be supplied varies considerably and has a large effect on the performance of the combustor.

The one dimensional problem of heat addition in the ducts has been completely solved. It has been found that heat may be added in a duct until the Mach number on a certain cross-section (most often the outlet) reaches unity.

In order to attain high combustion intensities (defined as the heat released in a combustor per unit volume and time) several methods have been suggested, the most important of which are (i) the use of catalytic combustion and, (ii) evaporation and injection of the fuel vapour. No work on catalytic combustion has been reported as yet, although the proposition seems rather attractive.

Regarding the method of fuel evaporation, it has been found that aerated kerosene vapour can be burned by upstream injection. The air was mixed with the fuel in order to reduce its tendency to "crack" and form carbon, but later experiments have shown that, if the vapour temperature is kept below 450 deg. C., air mixing is unnecessary. Flame stability persisted up to an air velocity of 200ft/sec.

The use of altitude chambers has indicated that the performance of the combustor is adversely affected as the static pressure is decreased. A part of this loss is associated with poor atomization by virtue of the low fuel flows required. Moreover, there is also sufficient evidence to indicate that there is a fundamental loss due to the increase of the ignition lag and other reasons.

On the subject of fuels which may be burned in ramjets, the report gives a generalized survey of the properties of a wide variety of elements, and concludes that the only liquid hydride which is stable at ordinary temperatures, and which is superior in gravimetric calorific value to liquid hydrocarbon fuels, is stable pentaborane.

From comparative cycle calculations it was found that, owing to its lower gravimetric calorific value, aluminium has a 50 per cent higher specific fuel consumption than kerosene: on a volumetric basis, however, the reverse is true. The possibility of the production of boosted fuels by the use of isotopes and nuclear methods is in its infancy, and it is as yet too early to foresee any results from which reliable conclusions may be drawn.

The author of the report then gives a general performance analysis from which, for given conditions of operation, the optimum distribution losses will result and, in dealing with regulation, states that, due to lack of a hot supersonic tunnel for investigations, very little is known of the operation of ramjets at points other than the design point. From tests in a cold supersonic tunnel, and from theoretical analysis, it has been established that, when a supersonic ramjet operates in a region of smaller Mach number than that for which it was designed, rapid rise in specific fuel consumption occurs, although when it operates at higher Mach numbers, the rise in specific fuel consumption is not so pronounced.

In a simple ramjet, the variable quantities for control are three in number, namely, the fuel quantity, the inlet area and the propelling nozzle area.

The fuel quantity fixes the maximum temperature. The variation of the inlet area aims at the achievement of an optimum external drag and inlet pressure recovery, and finally, the exit area is used to vary the thrust. Unfortunately, this is not always feasible, because, at supersonic flight speeds, critical conditions at the entry and exit may appear, and this places a restriction on the independent variation of the three parameters.

Finally, it may be added that simplicity, reliability, duration of flight and manufacturing costs are decisive factors for the selection of the quantities to be regulated.

APOLLO PROGRESS

HAVING now been moved into the final assembly shed at Baginton, the AW 55 Apollo is busily being groomed in readiness for its initial flight trials. These can be expected early in the New Year. As we go to press, two engines have been delivered and are ready for installation, whilst the remaining two Mambas are expected to be delivered within the near future. Preliminary functioning trials of the undercarriage installation have been started, and although the elevator and rudder are in position, the ailerons and flaps have yet to be installed. The attractiveness of the aircraft, which was so readily apparent from the models and full-scale mock-up, is, if anything, emphasized in physical actuality.

The second Apollo (chronologically) is almost complete in major component break-down state. This aircraft, however, will not fly; it is destined for vibration and strength tests. The third aircraft, i.e., the second flying prototype, is now in course of construction in the jigs.

During our visit to Baginton, we naturally enquired of other activities and learned that, although the Nene-engined AW 52 is now undergoing inspection and sundry modifications—it having completed about thirty hours' flying—the Derwent-powered version is now flying at Bitteswell and, of course, is continuing the research programme basically common to both of these machines.

In addition, flight trials with the AW 52G glider are now to be resumed, a new tug, a Lancaster, having been acquired. The flight trials with the glider are, of course, complementary to those with the turbojet 52s, and in some respects a glider offers certain advantages over a powered aircraft for fundamental flight research. For example, no allowance need be made for the windmilling drag of engines, which quality will, of course, vary with speed and altitude, and for sundry aerodynamic investigations this simplification makes the aerodynamicist's job a good deal less involved.

A new departure in Armstrong Whitworth activity is, in common with that of many other aircraft companies today, the design and manufacture of guided missiles. This work is being inaugurated at the company's Whitley establishment under the leadership of Dr. Leslie Newman.

Naturally enough, very little can be said at this stage about the nature of the work being undertaken, other than that it is concerned with guided missiles and rockets for naval and anti-aircraft use.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

PETROL TAX

Appeal for Removal of Unfair Burden

WE agree with the statement in British European Airways' accounts just published that there is "full justification for re-examination of the effect of the 9d a gallon *motor spirit* duty which has to be paid on all aviation spirit used within the U.K." The £90,000 duty payment referred to by B.E.A. is part of a larger sum of £645,000 paid annually by the aircraft engineering industry, the State-owned and private airlines, and the flying clubs.

The duty falls on all aviation spirit used within the U.K. This includes the bench testing of aero engines, trial flights and ordinary flying. The duty is anomalous and unjust, and it is hoped that it will be repealed in the next Budget.

This statement is issued by a committee composed of representatives of the following bodies:

The Society of British Aircraft Constructors,
The Royal Aero Club,
The Association of British Aero Clubs,
The British Air Charter Association,
The Air Transport Section, London Chamber of Commerce.

Westminster, S.W.1.

HYDROFINS

Some Early Experiments by the Bristol Company

YOUR description (November 11th) of the most interesting Hook Hydrofin marine craft was prefaced by mention of hydrofoil experiments by Graham Bell, Forlanini, Crocco and Tietjens; they are the classic names in this connection, but for some reason the equally valuable work of British experimenters rarely receives the mention its deserves. In particular, the experiments of Lieut. C. D. (now Sir Charles Dennistoun) Burney, R.N., in conjunction with the Bristol Aeroplane Company (then the British and Colonial Aeroplane Company) in 1912 and 1913 are almost forgotten. Nevertheless they did, to a large extent, bridge the gap between the early trials of Forlanini and the later work of Graham Bell and led to the most valuable invention of the paravane for mine-sweeping. They also received a limited amount of backing from the Admiralty.

The first of these seaplanes was a monoplane designed by Frank Barnwell (his first design for the "Bristol" firm) in the spring of 1912, incorporating the ideas of Lieut. Burney. It was equipped with a water-cooled radial engine (80 h.p. Canton-Unné) which, through clutches, could drive either a normal tractor airscrew or a pair of water propellers. The water propellers were located at the lower ends of the two front hydrofoil-supporting struts (known as "hydropeds") and a third hydroped aft carried a water-rudder, a small variable-incidence hydrofoil, or "water-elevator," being added later. During the trials in May, 1912, at Dale, Pembrokeshire, it was found possible to taxy by means of the water-screws until only two or three hydrofoils on each leg were submerged, but attempts to rise farther out of the water resulted in instability and the aircraft heeled over. As this was thought to be due to propeller torque, further trials were made by towing it behind a destroyer and on one occasion the seaplane became airborne, while the towing vessel was making 12 knots against a 30-knot wind. Unfortunately, as the tow rope was slipped while the aircraft was still in a climbing attitude, it stalled and was wrecked.

A further seaplane was built at Filton in March, 1913, being fitted with an 80 h.p. Gnome rotary engine. In this model the water propellers were mounted back-to-back on a separate central strut, so that their torque reaction was cancelled out. This, combined with other refinements, resulted in excellent taxying characteristics when the water propellers were in operation, but the effect of clutching-in the airscrew was to pull the nose down, which, of course, increased water-drag and prevented the necessary take-off speed being reached.

No doubt this trouble could have been cured had the aircraft not struck a submerged sandbank and capsized, which put an end to the trials. The "Bristol" pilots of these early seaplanes were George B. Dacre and Harry K. Busteed, both now Air Commodores (retired) after distinguished Service careers largely spent in seaplane development. Frank Barnwell prepared a design for a more advanced hydrovane boat (Bristol Type 66) with a Napier Lion engine, in 1921, but this was never built.

The enclosed photographs show details of the hydropeds and water propellers of the 1913 seaplane, the aircraft taxying with only two or three hydrofoils submerged and the final disaster after the premature slipping of the tow rope.

Bristol Aeroplane Co., Ltd. K. J. G. BARTLETT.

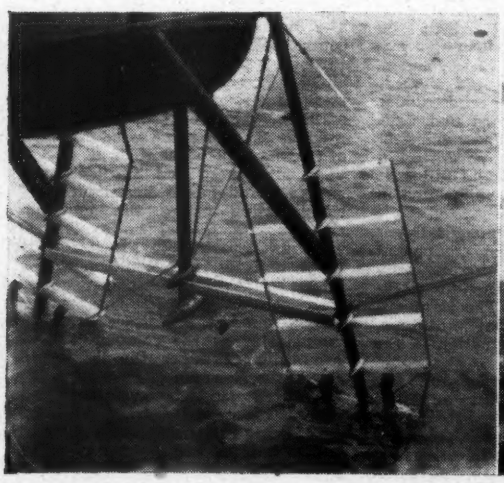
FLYING-BOATS AND THE AIRLIFT

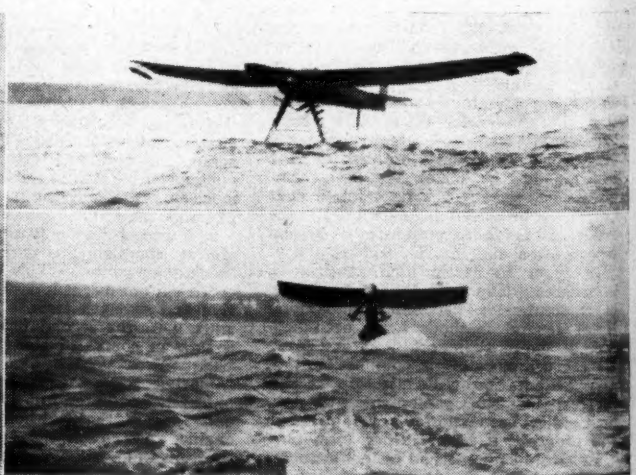
If Only We Had Shetlands in Numbers!

OPERATION *Plainfare* (the Berlin air-lift) has taught us many very valuable lessons. One of the most important is that weight-lifting air freighters are useless without adequate runways. The DC-7 Globemaster can land 20 tons per trip at Gatow; yet after 23 landings she was not allowed to come again because her 160,000 lb loaded weight damaged the runway too much. The Station Commander at Gatow, Grp. Capt. B. C. Yarde, told me that 60 Globemasters could do all the present work of *Plainfare* on their own, but for the runway problem.

But right next to Gatow is an alighting area with runways which would take the 140-ton (still unnamed) Saro A 45, or a boat the size of the *Queen Elizabeth*.

I refer, of course, to the Havel See from which three squad-





rons of Sunderlands, and some civil Hythes are operating regularly when visibility permits.

If the Air Ministry had placed an order for Shetlands so that we had had 100 or more in service at the end of the war, some of them could have been converted into civil airliners so that Britain could have been a leader instead of a follower in civil aviation, and *Plainfare* could have operated a large number from the Havel See, carrying a load nearly as great as the Globemaster without the worry of breaking runways.

The Berlin situation could arise again from different reasons and in different circumstances. So let us see to it that under similar future circumstances we have the load-carrying flying-boats.

GEOFFREY DORMAN.

Redburn Street, S.W.3.

SINGLE-ENGINE PERFORMANCE

Difference Between Fixed and V.P. Airscrews

YOUR correspondent, Eric A. Starling, has aroused many interesting memories for me, some of which may reflect upon the problem of single-engine performance.

Having flown "Dragon-Rapides" for many hours and "privately experimented" with single-engine performance, the following are my conclusions. I would interject here that my most familiar acquaintance with this good old-timer was on such an aircraft fitted with two 200 h.p. "Gipsy-Six" air-cooled in-line engines (Rotax starters), each engine having at the rear a 38-gallon fuel tank.

With airscrews of the non-variable pitch type it proved far better to leave the guilty engine to windmill. Turnings-in on circuit, especially when entering upon crosswind legs, brought about an acute shuddering effect upon a stationary airscrew. With due respect to the skill of the pilot mentioned in Eric A. Starling's letter, I would question the advisability of stalling the aircraft in the event of engine failure, merely for the purpose of arresting one airscrew. Shortly before the end of the war, however, I had an opportunity of experimenting again on this point, this time the airscrew being of the de Havilland manually operated variable-pitch type. On this occasion, a stationary airscrew, when fully feathered, afforded not the least discomfiture either to myself or the crew. This last test was carried out in an atmosphere of considerable turbulence, so some significance may be attached to the foregoing observations.

It should be remembered, however, that biplanes have certain fundamental handling differences when compared with monoplanes, and in this light these conclusions apply only to this particular biplane The Rapide would handle beautifully in the hands of an experienced pilot, even on one engine, though reflection may lead one to consider this particular aircraft to be rather "temperamental" when making single-engine cross-wind landings, there being a noticeable tendency to drop a wing irrespective of a stationary, fully feathered airscrew.

It should be remembered, too, that few Rapides as such were on service with the Royal Air Force. The service counterpart, the "Dominie," had an all-up weight of 5,850 lb, compared with the Rapide's maximum weight of 5,550 lb. These same single-engine observations apply, however, no noticeable difference being observed due to an increase in weight of some 300 lb. In each aircraft the wing aspect ratio was 11.7 accompanied by a three-degree dihedral.

Swilly, Plymouth. GORDON W. E. COLLINS.

H. G. BRACKLEY—AN APPRECIATION

AIR COMMODORE H. G. BRACKLEY, C.B.E., D.S.O., D.S.C., F.R.G.S., A.F.R.Ae.S., was, as briefly reported last week, drowned while swimming at Copacabana Beach, near Rio. He was making a tour of B.S.A.A. routes and stations in South America.

With the death of Air Commodore Brackley ("Brackles" to his friends) British aviation has lost one of its best-liked personalities. He combined with a quite unusual personal charm a capacity for organization which had already taken him far and would have taken him farther still. As chief executive of British South American Airways he had been given a chance to do something big, and he would have made the most of his opportunities. "Brackles" was a great flying-boat enthusiast, and when the editor of *Flight* saw him a few weeks ago, he said: "The more I see of the S.R.45 the more optimistic I get." The previous day he had attended a technical meeting at Cowes, with representatives of the interested parties present. He described that meeting as a model of what a technical meeting should be but so rarely is. Everyone helpful, with practical, sensible criticisms and suggestions. It is a sad thought that now he will take no part in bringing to execution the great plans which he helped to lay.

Air Cdre. H. G. Brackley.

Herbert George Brackley was born in 1894 and educated at Sevenoaks School. He served in the Royal Naval Air Service and Royal Air Force in the first world war and was awarded the D.S.O. and D.S.C. After the war he was one of the entrants in the 1919 west-east Atlantic flights, but when Alcock and Brown made the flight in a Vickers Vimy, Brackley gave up the attempt and flew the Handley Page V/1500 from Newfoundland to New York instead. The following year he was an entrant in the London-Capetown flight. First to complete this was a Vickers Vimy. Brackley was piloting a Handley Page O/400 but had engine trouble, and crashed the machine in a glide landing near Khartoum.

For a year or so he was chief pilot to Handley Page Transport, and then went as a member of a British aviation mission to Japan, where he survived the earthquake

When the separate operating companies were amalgamated into Imperial Airways, Brackley became Air Superintendent under Woods-Humphery. When the second world war broke out Brackley was appointed Deputy Air Officer, Admin., and Senior Air Staff Officer of No. 19 Group, Coastal Command, under Air Chief Marshal Sir Frederick Bowhill. When the latter was asked to form R.A.F. Transport Command, he persuaded the Air Ministry to let him have Brackley as S.A.S.O. He was awarded the C.B.E. in 1941, and in 1947 he organized the B.O.A.C. evacuation of nearly 42,000 from India and Pakistan, as described in *Flight* of December 25th, 1947.

After a period as assistant to the chairman of B.O.A.C., Brackley was appointed chief executive of British South American Airways, succeeding Air Vice-Marshal Bennett. There is little doubt that he played a decisive part in getting a firm decision on the large flying-boat programme in which he was such a convinced believer, and which he advocated with persuasive force.

To Mrs. Brackley and her sons and daughter we extend our sincere sympathy in their sad bereavement.

FORTHCOMING EVENTS

Nov. 25th.—Royal Aeronautical Society: "Development of the Armstrong Siddeley Mamba Engine," W. H. Lindsey, M.A., A.F.R.Ae.S.

Nov. 26th.—R.Ae.S. (Portsmouth): "Lighter-than-air Craft," Lord Ventry, Companion R.Ae.S.

Nov. 27th.—S.L.A.E. (South Eastern Area): "Gas Turbine Power Plants," by D. H. Mallinson, B.Sc., Manson House, 26, Portland Place, London, W.1. at 3 p.m.

Nov. 27th.—West London Aero Club: Dance.

Nov. 30th.—R.Ae.S. (Glasgow): Lecturettes at Prestwick Airport.

Dec. 1st.—R.Ae.S. (Weybridge): "The Island Campaign," W. Courtenay, M.M., A.R.Ae.S.

Dec. 1st.—Royal United Service Institution: "Airborne Forces," Major General A. J. H. Cassels, C.B.E., D.S.O.

Dec. 1st.—R.Ae.S. (Luton): "The Light Aeroplane and the Future of Private Flying," P. G. Masefield, M.A., F.R.Ae.S.

Dec. 2nd.—R.Ae.S. (Isle of Wight): "The Development of the Armstrong Siddeley Mamba Engine," W. H. Lindsey, M.A., A.F.R.Ae.S.

Dec. 2nd.—Royal Aeronautical Society: "Problems in the Development of A New Aeroplane," G. R. Edwards, M.B.E., B.Sc., F.R.Ae.S.

Dec. 3rd.—R.Ae.S. (Portsmouth): Film, "How an Aeroplane Flies."

Dec. 7th.—R.Ae.S. (Graduates and Students): Papers read by Members.

Dec. 7th.—Handley Page Engineering Society: "Aircraft Photography," John Yoxall.

Dec. 7th.—R.Ae.S. (Belfast): "The Weight Aspect in Aircraft Design," L. W. Rosenthal, A.F.R.Ae.S.

Dec. 8th.—R.Ae.S. (Preston): "Gusts," Prof. A. A. Hall, M.Sc., M.A F.R.Ae.S.

Dec. 9th.—R.Ae.S. (Coventry): Lecture by E. Smith.

Dec. 11th.—British Interplanetary Society: "The Problem of Interplanetary Flight (Part I.)—Two Papers. "The Dynamics of Interplanetary Flight," A. C. Clarke and "Limitation of the Chemical Rocket," A. V. Cleaver.

Dec. 14th.—R.Ae.S. (Belfast): Film Evening.

Dec. 15th.—R.Ae.S. (Weybridge): Annual General Meeting.

Dec. 15th.—Herts and Essex Aero Club: Annual Ball, Park Lane Hotel.

Dec. 16th.—Royal Aeronautical Society: "Present thoughts on the Use of Powered Flying Controls in Aircraft," D. J. Lyons.

Dec. 16th.—R.Ae.S. (Isle of Wight) Annual General Meeting and Film Show.

SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements

CRUISING CHECK: A Handley Page Hastings was the subject of a recent fuel-consumption test in the Mediterranean area, flown and serviced by members of the Empire Flying School's Handling Squadron. The towering Rock in the background locates this scene at Gibraltar, the final point in the flight before return to Hullavington.

Naval Appointments

IT is announced by the Admiralty that Vice-Admiral C. E. Douglas-Pennant, C.B., C.B.E., D.S.O., D.S.C., has been appointed Flag Officer (Air) Mediterranean, and Second in Command, Mediterranean Station, in succession to Vice-Admiral Sir Thomas H. Troubridge, K.C.B., D.S.O.

Capt. (E) W. S. Jameson, C.B.E., is promoted to Rear-Admiral (E), and takes up the duties of Rear-Admiral in charge of Reserve Aircraft and Technical Training.

R.A.F. Appointments

BRIGADIER M. A. JAMES, V.C., D.S.O., M.C., formerly Command Regiment Officer, B.A.F.O., Germany, has succeeded A. Cdre. F. W. Long, C.B., as Director of Ground Defence, Air Ministry. A. Cdre. Long becomes Director of Operations at the Air Ministry. The new Director of Ground Defence won his V.C. while serving at Cambrai in March, 1918; his association with the R.A.F. Regiment dates from October, 1945, when he went to B.A.F.O. H.Q.

It is reported that A. Cdre. S. O. Bufton has been appointed a Staff Officer to Air Chief Marshal Sir James Robb, the C.-in-C. Air Forces, Western Europe. A. Cdre. Bufton is a former Director of Bombing Operations at the Air Ministry.

Auxiliary Appointments

APPOINTMENTS of commanding officers for two units of the Royal Auxiliary Air Force are announced by the Air Ministry. W/C. T. Adam is to command No. 3612 (County of Aberdeen) Fighter Control Unit, located at R.A.F. Station Dyce, and S/L. J. F. Featonby takes over No. 2608 (North Riding) L.A.A. Squadron (R. Aux. A.F. Regiment).

Commonwealth Jets

TWO-SEAT jet fighters may possibly go into production in both Canada and Australia. In a recent address to the Canadian Ordnance Association, Mr. Brooke Claxton, Defence Minister, stated that Canada's major development project at present was a long-range, two-seat, twin-jet aircraft, being produced by A. V. Roe (Canada), Ltd. If the aircraft were successful, stated Mr. Claxton, it would supply a need not met by any other known type, and production would follow "for ourselves and other countries."

The Australian journal *Aircraft* reports that the Commonwealth Aircraft Corporation may design and construct for the R.A.A.F. a two-seat Nene-powered fighter, embodying certain features of the American Grumman Panther naval fighter, although no definite specification has yet been decided upon by the Air Force. No mention is made, however, of the rumoured production by this concern of the Hawker N.7/46 (*Flight*, Nov. 11th), which might render manufacture of the Australian design unnecessary.

In Parliament

WHEN the Prize Bill, recently given its second reading in the House of Commons, becomes law, Royal Air Force charity and welfare organizations will benefit by £1,250,000. This represents the R.A.F.'s share of money realized by the capture of enemy ships in the war, and the sum was earned largely by the work of Coastal Command. The £5,250,000 allotted to the Royal Navy and Merchant Navy will be distributed among wartime members on a shares basis. The Bill for the Recall of Army and Air Force Pensioners was also read for a second time recently. Under this Bill about 2,000 R.A.F. pensioners who left the Service during or since the war will have the option of remaining free from liability to recall on the old pension rates, or of becoming liable to recall on the new pension rates which were introduced in December, 1945

R.C.A.F. "Pitifully Small"

SPEAKING in Toronto on Monday, November 22nd, Air Marshal R. S. Leckie, former Chief of the Canadian Air Staff, said that the R.C.A.F. was pitifully small—"almost to the point of impotency."

Expressing the hope that the Air Force would be built up to combat strength again, the Air Marshal said: "I accept my share of the responsibility." As Chief of Air Staff he had shared the prevailing post-war view that future conflict was a remote possibility of the far-distant future.

Scottish Ceremony

AT a ceremonial parade of Edinburgh University Air Squadron in the Old Quadrangle at the University on Sunday, November 14th, the squadron was presented with its newly approved official badge, which consists of an open book, symbolic of learning, on the background of a thistle, with the motto "Summa Petunt Juvenes" (Youth Seeks the Highest). The official copy of the badge, signed by H.M. the King and the Chester Herald (Inspector of R.A.F. Badges), was handed over by A. Cdre. E. S. Burns (A.O.C. No. 66 Group, R.A.F.) to the unit commander, S/L. K. M. Murray, D.F.C. In doing so, the A.O.C. said that this was the visible sign of the unit being accepted into "the finest fighting service in the world." After handing over the badge, A./Cdre. Burns also presented the Duke of Sutherland's cup, given to the squadron four months ago for award to the best officer-

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cadet of the year, assessed on flying ability, aptitude in ground training and general keenness. It was won for the first time by Officer Cadet R. C. Foote, who is in his third year with the squadron, and has 114 flying hours on his log, including 62 hours solo.

The Squadron had nearly 50 officers, officer cadets and airmen on parade. Its recent recruiting campaign met with marked success, and it is in the happy position of being able to choose from 46 applicants for the 25 vacancies in the unit.

Boy Entrants Complete Training

THE Inspector-General of the R.A.F., Air Marshal Sir Leslie Hollinghurst, took the salute at the first post-war passing-out parade of boy entrants in engine, airframe, electrical and instrument mechanic, and aircraft finisher trades at Locking on Tuesday (November 9th). A similar parade for boy entrant telegraphists was held at Compton Bassett recently, when Air Marshal Sir Victor Goddard, the Air Member for Technical Services, took the parade. Armament mechanic entrants are trained at Kirkham, near Blackpool, and the Director-General of Armament at the Air Ministry, A.V-M. G. Pidcock, attended the passing-out ceremony of the first entry to take the course.

U.S.A.F. University Lecture

AIR MARSHAL THE HON. SIR RALPH A. COCHRANE, the Air Officer Commanding-in-Chief, Flying Training Command, left by air last week for America, where he is to lecture at the Air University of the U.S. Air Force. Sir Ralph will also make liaison visits to the U.S.A.F. before returning next month via Ottawa.

Hospitality for Air-lift Crews

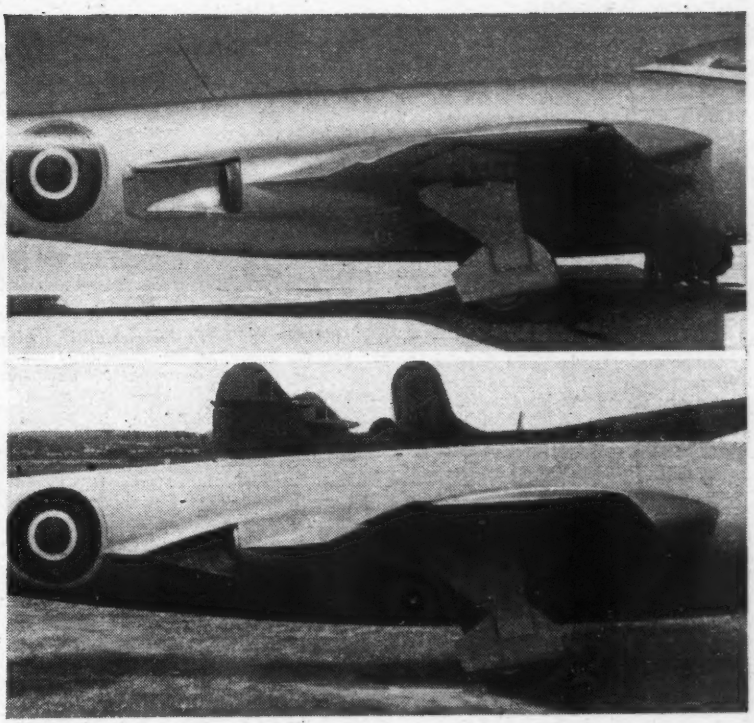
SPEAKING over the B.B.C. on November 13th, on his return from a survey of the air-lift bases, Mr. Arthur Henderson, the Secretary of State for Air, appealed for British families to entertain Commonwealth aircrews on leave from the operation. His request was fully met by 3 p.m. the next day, when a total of more than 250 offers had reached the Air Ministry alone. It is pointed out by the Ministry that the Secretary of State's appeal was supplementary to the good work already done in this direction by organizations such as the Victoria League, and the Dominion Fellowship Trust, and also by Commonwealth Air Forces' Headquarters in London.

Leave for the R.A.F.

ACCORDING to new leave scales for the R.A.F. which have lately been introduced the basic leave allowance for Regular officers and airmen serving at home remains at 30 days a year. An extra 12 days will be given to officers, warrant officers, and flying personnel, at the discretion of commanding officers, and to airmen instructors. When pre-war scales of leave for Crown servants generally are restored, officers of the rank of flight lieutenant and above may be given a further 19 days for overseas travel or other purposes calculated to improve their efficiency and value to the Service, but this leave will not be granted in consecutive years. Leave is also given for public holidays, and twelve 48-hour passes (normally confined to week-ends) may be granted during the year. A 48-hour pass may be added to a period of annual leave three times a year.

For those serving in North-Western Europe the scale is 52 days' leave a year. A married man who has been joined by his family will normally take this leave locally, but others may take 42 days of it in the U.K. Disembarkation leave from N.W. Europe is 21 days for men returning home with their families, and seven days for others. In other Overseas Commands the leave scale is the same as for home service. Disembarkation leave is 14 days after six months abroad, plus one day for each additional month. Part of the annual leave may be saved until returning to the U.K. and added to disembarkation leave, but the total must not exceed 60 days. National Servicemen joining the R.A.F. from next year will be eligible for 14 days' annual leave if serving at home, and 21 days if abroad, with additional leave for aircrew trainees.

Free travel will be allowed to all personnel up to a maximum of three journeys a year. All scales apply equally to the R.A.F., the W.A.A.F., and Princess Mary's R.A.F. Nursing Service.



ALTERED OUTLET: These two views of the Hawker P.1040 prototype reveal modification of the fairings for the twin tail pipes of its Rolls-Royce Nene. The newer configuration is shown in the lower photograph.

"Sunray" Stepped Up

THE monthly operation known as Exercise "Sunray," which was begun by Bomber Command in the summer of 1947, has been enlarged. Previously, six bombers left each month for the Middle East, accompanied by ground crews in Transport Command aircraft, but the total is now twelve Lincolns or Lancasters and three Mosquitoes. During their stay, which lasts a month, the aircraft are based at Shallufa, in the Canal Zone of Egypt, and live bombing and air firing is practised. Exercises are performed with overseas-based R.A.F. fighter squadrons. The name "Sunray" conveys more meaning than many operation code-names, as the aim in this case is to permit more intensive training than is normally possible in this country's climatic conditions.

Reserve Exhibition

THREE large models showing training of R.Aux.A.F. and R.A.F.V.R. personnel are the R.A.F.'s contribution to the "Spare Time for Britain" Exhibition which was due to be opened at the corner of Oxford Street and Quebec Street (near Marble Arch), at 10 a.m. on Tuesday, by the Rt. Hon. A. V. Alexander, Minister of Defence. An airfield will be the central theme for showing general training activities and there will also be a scale model Fighter Control Unit. The third model, a large-scale reproduction of a radar scanning aerial, also features the work of F.C.U. members. The Exhibition is open until Saturday, December 18th.

Squadron Badges

MANY readers will remember the series of R.A.F. squadron badges published exclusively in *Flight* during 1945 and 1946—especially the hundreds who wrote to us desirous of buying copies. Unfortunately, the Air Ministry, which supplied the copies, informed us that it was not possible at the time to meet such a large demand. The request was recently repeated however, and we gladly

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pass on the information that photographic copies of the badges, size 8in by 6in, may now be obtained at a cost of 2s from the Information Division 1(c), Air Ministry, Parliament Square House, Parliament Street, London, S.W.1.

R.A.F. Calendar for 1949

IN the R.A.F.'s 1949 calendar, shortly to be circulated to all units, the page for each month bears a portrait of an Air Force holder of the Victoria Cross of the second world war, with an extract from his citation. The 12 V.C.s portrayed on the calendar are W/C. G. Gibson, Sgt. J. A. Ward, S/L. A. S. K. Scarf, F/S. G. Thompson, S/L. L. Trent, F/S. A. L. Aaron, W/C. H. G. Malcolm, W/O. N. C. Jackson, S/L. J. D. Nettleton, Sgt. T. Gray, F/L. D. E. Hornell, P/O. A. C. Mynarski.

Permanent Commissions

GENERAL DUTIES BRANCH.

Squadron Leaders: P. P. C. Barthropp, D.F.C., A. Brown, H. G. Fletcher, D.F.C., V. W. Hinkley, P. F. Illingworth, J. H. Kirkpatrick, D.F.C., F. V. Morello, G. N. North, A.F.C., L. R. J. Ovenden, A.F.C., C. L. C. Roberts, E. N. Southwell.

Flight Lieutenants: S. Allen, R. S. Ayton, D.F.M., M. Ballance, D.F.C., D. G. Ballard, W. H. Banks, B. Bardega, D.F.M., C. Bartlett, W. G. Baynton, A. W. Bedford, A.F.C., W. H. Bengree, V. Bridges, D.F.C., G. W. Buckland, D.F.C., R. H. S. Butt, E. R. Chalk, K. L. Charney, D.F.C., R. J. A. Church, D.F.C., D. H. Clarke, G. D. Cremer, G. G. A. Davies, D.F.C., R. L. Duncan, A.F.C., R. G. I. Elliott, P. N. Farlow, H. J. J. Franklin, H. A. Groves, E. G. Harrison, A. E. Henderson, A.F.C., M. A. N. Hills, C. J. Homes, A.F.C., C. S. Hunton, D.F.C., W. J. Hurst, W. Kent, J. B. Leetham, T. MacDonald, H. T. Murley, D.F.C., A.F.C., R. W. Payne, R. H. Pitman, D.S.O., R. Pocock, W. H. Pope, G. A. Richards, R. W. Richardson, R. S. Riches, J. A. Ruck, D.F.C., J. R. Saunders, D. I. Smith, M. B. Spalding, F. L. Spencer, J. R. Stoop, D. W. Sturgeon, P. D. Thorne, A.F.C., D. K. Warburton.

Flying Officers: K. Bailey, L. Booth, G. H. Dodd, H. G. P. Hine, L. W. Martin, E. R. McDonnell, E. P. Wildy.

TECHNICAL BRANCH.

Squadron Leaders: E. B. O'H. Bennett, H. S. Bowmaker, H. R. Crowley, A. S. Knowles, F. G. E. Loveridge, D. McDermott, C. D. Moore, C. Pattison, J. P. Pryer, M. E. Richards, N. Rowls, E. T. Tucker, N. L. Williamson.

Flight Lieutenants: H. G. Atterwill, D. J. Barnes, L. S. Bates, B.E.M., E. Bean, A. S. Blake, L. P. S. Boggust, E. H. Briggs, W. J. Burton, D. H. Button, D.F.M., J. E. Calman, A. E. Chandler, F. Church, A. C. Cooper, S. W. Cornes, R. M. Cox, C. Cramp, D. W. Currie-Davies, L. R. De-Thier, J. Duckworth, K. M. Dunsford, F. W. Evans, W. J. F. Fenton, L. L. Flowerdew, F. B. L. Fowler, T. France, E. H. Fuller, W. J. Gear, C. W. E. Glidden, P. J. Griffiths, J. Gundry, B.E.M., S. I. Hardcastle, D.F.C., E. R. Hester, G. W. T. Hossent, W. R. Hughes, S. P. Ivanoff, R. A. B. James, R. F. Jones, J. MacKenzie, J. R. Marchant, N. E. Martin, G. W. M. Merritt, B.E.M., A. R. Mitchell, S. H. Mitchinson, D.F.M., E. R. Morfill, A. P. Morgan, D.F.C., A. R. Newman, J. Ninian, D.F.C., D. A. Oliver, W. A. Overall, R. J. Palmer, M.B.E., F. Pakes, J. A. Parker, M.B.E., W. C. Parsons, J. Patterson, C. H. W. Percy, H. F. Poulson, A. T. Prince, D.F.M., W. E. Putz, G. D. P. Quinn, D.F.M., P. V. Rowbotham, H. G. A. Scilley, J. C. Shaw, R. J. Sills, O.B.E., C. Sinclair, A. W. Skingsley, B.E.M., H. W. Smith, L. H. Smith, S. W. G. Smith, S. Snell, F. H. Spicer, H. E. Stallworthy, L. O. Stephens, R. H. Stephenson, W. B. Stoneman, F. G. Thouard, M. J. Underhill, J. A. Walters, C. G. H. Weale, R. D. Yandell.

Flying Officers: G. Austin, W. H. E. Austin, R. Carman, H. W. Chiverton, A. J. B. Clements, J. C. Forsyth, G. V. Hanna, D. E. C. Lockyer, A. A. R. L. M. Morris, F. W. Neeve, R. R. Schofield, J. R. B. Seal, G. W. Slack, C. D. Sorrie, R. Starr, W. H. Tew, R. F. C. Winzar.

EQUIPMENT BRANCH.

Wing Commander: G. H. Harris.

Squadron Leaders: A. L. Cornford, A. P. B. De Mornay, E. Easton, T. J. Goggin, J. S. Miller, H. R. E. Rumsey, L. J. M. Westcott.

Flight Lieutenants: W. E. Allen, W. L. Bass, D.F.C., W. E. Barrow, W. J. Baser, D.F.C., J. Burridge, A. Childs, B. W. E. Churchill, R. V. Derbyshire, C. C. Harvey, G. R. Henrie, G. K. King, D.F.C., J. E. Parr, B. E. K. Pemberton-Piggott, F. H. Price, S. G. Price, R. C. Shepherd, D.F.C., H. S. Tardrew, C. G. True, L. G. Watkins.

Flying Officers: S. J. Acons, D. Armitage, R. T. Bagley, J. W. Baldock, H. A. Barker, R. Bulley, L. Bullock, M. H. Clubbe, W. E. Evans, E. E. Harding, P. S. Hose, E. Kenyon, R. E. Lipscomb, B.E.M., J. P. F. Lloyd, L. J. Logan, A. G. A. Luke, A. Munro, E. Parkin, B.E.M., W. J. C. Powell, L. G. Prest, C. F. Reed, T. Roberts, K. J. L. Rothery, F. H. J. Skeet, R. Stamp, A. H. Thornalley, F. J. Tomblin, G. G. E. Truckel, J. Tuck, H. E. C. Wakefield, H. F. Whiteman, T. B. Williams, G. Wilton, G. H. Yeo, M.B.E., E. W. Young.

Pilot Officers: L. S. Davey, W. C. Ford, N. Friend, D. A. Gilbey, W. A. Long, A. G. Martyn, J. K. Smith, R. L. Walker.

SECRETARIAL BRANCH.

Wing Commander: R. Hanson.

Squadron Leaders: D. M. Barrett, R. Beal, E. V. Cunliffe, M.B.E., D. I. C. Eyres, W. E. Farrow, A.F.C., S. Findlay, E. V. Hambry, R. How, W. C. Penney, F. G. Rands, F. H. Rock, K. J. F. Toop.

Flight Lieutenants: D. W. Ansell, M.B.E., H. L. Ashley, F. Barrett, T. V. Blinman, J. W. D. Brangan, D. H. Castle, T. C. Currie, B. L. Davis, R. C. Dunbar, D.F.M., C. F. Fennell, D.F.M., G. E. Goodchild, C. V. Haines, A.F.C., P. C. Hunt, J. Irvine, J. E. Johnston, B. A. Law, A. J. D. MacLachlan, D.F.C., E. J. Mason, M.B.E., R. T. Mason, E. H. McCullough, J. G. McKoewn, I. C. Murison, A.F.C., C. A. Newberry, H. J. O'Brien, D.F.C., G. P. Owen, M.B.E., I. A. Perry, N. H. Potts, S. R. Roberts, A.F.C., G. Robson, J. W. Roch, D.F.C., G. W. Sleigh, R. P. Smith, P. A. Stiff, J. E. R. Vosper, T. H. Warren, D.F.C., B. A. P. Williams, M. Williams, G. R. Winter.

Flying Officers: S. Bright, F. R. B. Brown, F. S. Dunn, G. Forsyth, B. N. Grant, M. J. Hills, D.F.C., T. H. Hodgson, W. W. McD. Inglis, D. Knight, R. Levente, I. F. Mitchell, J. G. M. J. Moorat, M. Owen, M.B.E., H. G. Pearman, A. B. M. Simnett, L. A. H. Wardill, J. W. C. West, R. F. A. Wren.

Pilot Officer: R. C. Cawrse.

"Flight" photograph.

***MILITARY VERSION:** Features distinguishing the Vickers Valetta from its civil counterpart the Viking, include double-entry doors, 5ft 10in in height, and 8ft 6in wide, and a modified tail incorporating a glider-towing hook.*

***FROM BOSCOMBE:** Contributing to Boscombe Down's victory in the Lord Wakefield Novices' Boxing Tournament for R.A.F. officers were (L. to R. upper row) F/S. Williamson (second); P/O. Budd (heavy-weight); W/O. Watt (trainer); F/L. Sutton (welter-weight); F/S. Egan (second); (lower row), F/L. Crozier (feather-weight); S/L. Spiers (light heavy-weight); A. Cdre. Patch, C.B.E. (Station Commander and Chairman of R.A.F.B.A.); S/L. Blackstone (middle-weight); F/L. Evans (light-weight).*

Reunions

ALL former members of No. 239 (Bomber Support) Squadron interested in a reunion planned in London for the early New Year, are asked to contact L. J. S. Spicer, 37, Martyrs Field Rd., Canterbury, Kent.

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A reunion of No. 826 Fleet Air Arm Squadron will be held at the R.N.V.R. Club, 38, Hill St., London, W.1, on Saturday, December 4th, at 6 p.m. All past and present officers invited. Write D. M. Judd, Priors Cottage, Cobham, Surrey.

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